



**SOCIO-ECOLOGICAL RELATIONS ASSOCIATED WITH BIJAO  
PRODUCING AREAS (*Calathea lutea*) IN CENTRAL-EASTERN COLOMBIA†**

**[RELACIONES SOCIO-ECOLOGICAS ASOCIADAS CON LAS AREAS DE  
PRODUCCION DE BIJAO (*Calathea lutea*) EN EL CENTRO - ORIENTE DE  
COLOMBIA]**

**Nubia Carolina Higuera-Mora<sup>1\*</sup>, Alejandra González-Orozco<sup>1</sup>,  
Paola Andrea Suspe-Adame<sup>1</sup>, Iván Darío Medina-Rojas<sup>1</sup>,  
Sud Sair Sierra-Roncancio<sup>2</sup> and Raúl Hernando Posada-Almanza<sup>3</sup>**

<sup>1</sup> *Corporación Universitaria Minuto de Dios – UNIMINUTO. Cra. 74 #81 C-05  
Bogotá. Colombia. E-mail. nhiguera@uniminuto.edu*

<sup>2</sup> *Zenkinoko SAS. Diagonal 151b#136<sup>a</sup>-75. Casa 93. Bogotá. Colombia*

<sup>3</sup> *Universidad de Caldas. Calle 65 No 26 – 10. Manizales. Colombia.*

*\*Corresponding author*

### SUMMARY

**Background.** The bijao (*Calathea lutea*) is a plant of great importance since it has been used for years in the wrapping of an emblematic Colombian confectionery that is a cultural and financial staple in the area where it is produced. **Objective.** The aim of the research was to identify socioeconomic characters of peasant families dedicated to the production and sale of bijao leaf were, identify the main plant species that accompany bijao in the ecosystem and document the community's perception of the ecosystem services associated with the plant's ecosystem. **Methodology** For the development of this study, were used community interviews, questionnaires, workshops and verification visits at farms and cover forest areas and crop field with Bijao. **Results.** Predominantly, leaf production was conducted through family farming in transition, with women playing a fundamental role in the process. The community attributes an important ecological role to bijao, which is predicated on the protection and regulation of water, soil, climate and biodiversity. **Implications.** The study identified conservation values in an ecosystem where pressures exerted on the natural environment by agricultural production, urbanization and tourism prevail. **Conclusions.** The bijao leaf has socioeconomic importance and is part of the local tradition and culture of peasant families, the leaf is embedded in customs and gives identity to the territory. Women maintain the traditional knowledge of bijao for the next generations and it is an option of life and income for young people. The community recognized the environmental services and goods of the bijao areas on soil and water conservation. It provides conservation values of natural resources in an area with conflicts between forest conservation and where they produce agricultural goods.

**Key words:** Multifunctional agriculture; environment - society relationship; Bocado veleño

### RESUMEN

**Antecedentes.** El bijao (*Calathea lutea*) es una planta de gran importancia al proporcionar desde hace años la envoltura de una golosina emblemática colombiana que forma parte de la cultura y tradición y es una fuente de ingreso en la zona donde es producida. **Objetivo.** El objetivo de la investigación fue hacer una caracterización socioeconómica de las familias campesinas dedicadas a la producción y venta de hojas de bijao, identificar las principales especies de plantas que acompañan a bijao en el ecosistema y documentar la percepción de la comunidad sobre los servicios del ecosistema asociados con el ecosistema de la planta. **Metodología.** Para el desarrollo de este estudio, se utilizaron entrevistas, cuestionarios, talleres comunitarios y visitas de verificación en fincas y áreas de bosque de cobertura y campo de cultivo con bijao. **Resultados.** Predominantemente, la producción de hoja se hace mediante agricultura familiar en transición, con un rol fundamental de las mujeres en el proceso. La comunidad atribuye al bijao un importante rol ecológico, relacionado con la protección y regulación del agua, suelo, clima y la biodiversidad. **Implicaciones.** El estudio identificó valores de conservación en un ecosistema donde prevalecen presiones ejercidas al entorno natural por la producción agrícola, urbanización y turismo. **Conclusiones.** La hoja de bijao tiene importancia socioeconómica, es parte de la tradición local, está arraigada a las costumbres de las familias campesinas y da identidad al territorio. Las mujeres mantienen el conocimiento tradicional de bijao para las próximas generaciones y es una opción de vida e ingresos para los jóvenes. La comunidad reconoció los servicios y bienes ambientales de las áreas de bijao y que permiten la conservación del suelo y el agua. Esto proporciona valores de

† Submitted March 21, 2020 – Accepted June 22, 2020. This work is licensed under a CC-BY 4.0 International License.  
ISSN: 1870-0462.

conservación de los recursos naturales en una zona con conflictos entre la conservación de bosques y la producción de bienes agrícolas.

**Palabras clave:** Agricultura multifuncional, Relaciones ambiente – Sociedad, Bocado velleño

## INTRODUCTION

Colombia is one of the 14 megadiverse countries on earth, home to more than 10 % of the world's documented species (Ministry of Environment and Sustainable Development, 2014; IDEAM, 2015). According to the GBIF (Global Biodiversity Information Facility), about 56,343 species are registered, of which 54 % are plants. Some of this plant biodiversity is used in products such as food wrappers, whose processing and use represent great ancestral and cultural value (Díaz, 2011; SIBC, 2017). "Bijao" (*Calathea lutea*) is one of 14 species of Marantaceae family is found in the Americas and has been used mainly as a natural wrapping for "Bocado", a traditional Colombian confection made from ripe guavas and sugar (Van Huylenbroeck, et al., 2018; Jiménez and Palacios, 2011).

*Calathea lutea* belongs to the Monocotiledóneas, order Zingiberales and family Marantáceae, grows wild in tropical rainforests from Mexico to Brazil and in Colombia are found in 20 of the 32 departments (Van Huylenbroeck, et al., 2018; León, 2000; Cogollo, et al., 2007). Although poorly studied, the bijao leaf, in addition to providing aroma and conservation properties to the bocado, represents an important source of income for peasant families in the bocado producing area in the municipalities of Vélez, Barbosa, Guavatá, Puente Nacional and Moniquirá, a region formed by municipalities in the south of the department of Santander on the border with Boyacá (Prada, et al., 2006; Corpoboyacá, 2015). The importance of the bocado for Colombia is fully recognized through the "Denomination of Origin" Seal, a special category that the government grants to emblematic products that have great significance for the culture, tradition and economy of a region (Superintendence of Industry and Commerce, Resolution No. 37563, 2017). Bijao leaves have been utilized as bocado wrappers since the sixteenth century, and since then the technique has been passed from generation to generation. The process begins with the cooking of the green leaf, followed by washing, drying, deveining and cutting (Prada, et al., 2006; Rodríguez, et al., 2017).

On the other hand, an activity or function generated from ecosystems and their use with the purpose of satisfying human needs are known as ecosystem services (MEA, 2005, Montaña, 2006; Peña and

Muñoz, 2015; Urquiza and Cadenas, 2015). In order to recognize the ecosystem services associated with the bijao areas, a characterization of the socioeconomic conditions of peasant families dedicated to the production and sale of bijao leaf was carried out, investigating the type and valuation of the ecosystem services. Subsequently, an analysis was made of the socio-ecological relations that have arisen as a result of the use of the leaf.

## METHODS

### Study area and community

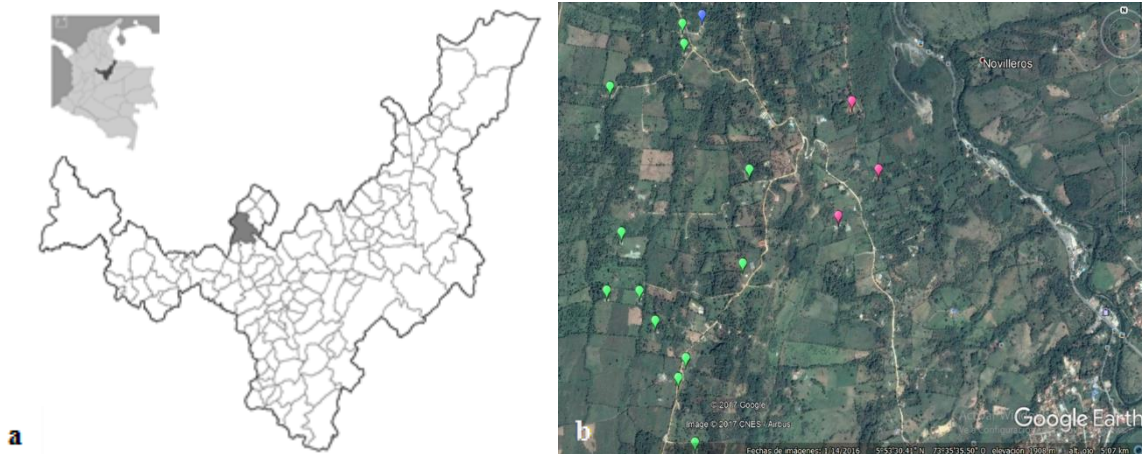
Sixteen families members of an association of peasant producing, transforming and commercializing the bijao leaf (*C. lutea*), were included in this study (Fig. 1b). These lands were located between 1800 and 2000 meters above sea level and with a temperature between 17 and 24°C located in the center-east of Colombia, Boyacá department, municipality of Moniquirá (Fig. 1a), San Esteban, Pueblo Viejo and Naranjal trails.

### Socio-economic characterization

Semi-structured interviews and questionnaires were conducted with 16 family units to investigate aspects such as occupation, type of work force, domestic and economic activities related or not to the bijao and differentiated by gender. The families were classified according to farming categories established by FAO 2014 (consolidated, in transition, subsistence). The information was analyzed using descriptive statistics (average and frequency) and validated through stakeholder dialogues and one community workshop.

### Associated vegetation and community identification and assessment of ecosystem services associated with bijao areas

Excursions were made through areas with bijao presence and samples were collected to identify the plant species currently being worked with, using the database of the Biodiversity Information System in Colombia (SiB Colombia) with the support of botanical catalogues (Maza and Builes, 2000, Cardona, Higuera and Hoyos 2010). The vegetation associated with bijao in the study area was identified and classified according to its use.



**Figure 1.** Study area **a)** Geographical location of the municipality of Moniquirá, **b)** Location of the related families. San Esteban Trail (green), Pueblo Viejo (pink), Naranjal (blue).

The identification and social valuation of the ecosystem services associated with bijao was carried out through one participatory workshop with members of sixteen families that emphasized the exchange of knowledge between researchers and the community with the premise of addressing issues were including: concept, importance, function and classification of services, as well as the stakeholders and interactions that occur within ecosystems. Finally, ecosystem services were identified and their value was assessed on a qualitative scale.

#### **Analysis of the socio-ecological relations of areas with bijao presence**

Social cartography was developed by means of one participatory workshop to draw a map with the community's perception of how physical space and natural resources have been used. It was possible to provide a visualization of the changes exhibited in the ecosystem, namely: water sources, municipal headwaters, land use (forests, agricultural activities, and urbanization) in chronological succession. Current and 20-year-old maps were contrasted in the villages of Pueblo Viejo, Naranjal, and San Esteban. The information was analyzed and compared with satellite images from 2009, 2013, and 2016 obtained from Google Earth®.

## **RESULTS AND DISCUSSION**

#### **Socio-economic characterization of the community working with bijao leaf**

The educational level of those working with Bijao ranges from secondary education (43.5 %), primary (33.3 %), basic secondary (10.1 %), higher education (10.1 %) and preschool (2.9 %). The lower percentage of workers with secondary and higher

education is due to the limited access to higher education in rural areas, which leads to displacement.

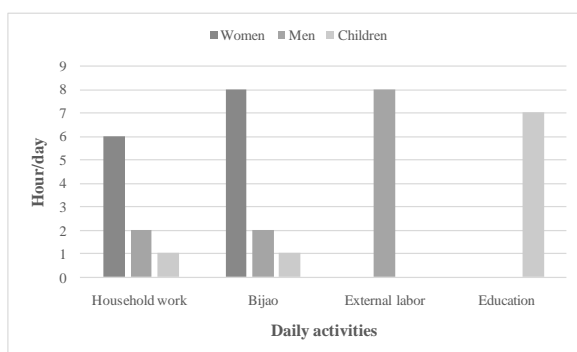
The average household consists of four members (father, mother and children), the 34 % are woman, 29 % are men and 37 % children; with 71.8 % of the population being adults (>18 years) and 28.2 % younger. The most important occupation is agriculture (56.9 %), followed by transport (9.8 %) and construction (7.8 %); 5.9 % are students, 5.9 % are housewives, and 7.8 % have other occupations (e.g. municipal bus dispatchers, servicemen, or day labourers). Pensioners represent 5.9 % of the population and are considered as neorural or neopeasant a phenomenon that is increasing in Latin America where more and more people migrate to the countryside to adapt to rural life (Gutiérrez 2002).

Family agriculture (FA) is characterized by the preponderant use of family labor force, limited access to land and capital resources, and its main source of income is agriculture (FAO, 2014); therefore, families producing bijao are classified in this category. In Colombia, family farming is divided into: subsistence family farming (78 %) characterized by insufficient income, without total coverage in public services, technologies or programs; transitional family farming (15 %) where there is access to public services, markets for the purchase and sale of agricultural products; and consolidated family farming (7 %) with large-scale production, greater access to public services, resources, land and markets (FAO, 2014; Acevedo, 2016b). For the present study, the main type of family farming found was transitional (76.5 %), followed by subsistence PA (23.5 %); there were no cases of consolidated PA, as no evidence of large-scale transformation was found.

Family agriculture accounts for 57 % of the agricultural labor force in the country and represents around 70 % of national production (Maletta, 2011; Acevedo, 2016b). In the area under study, 47.1 % of the farms use family workforce, 35.3 % hire some fraction of their labor, and 17.6 % hire their entire workforce. 52.9 % of the farms contract laborers for the sowing and harvesting of various crops (only two farms hire the entire workforce, as they are only 1-2 person families). In that order, most families have sufficient labor force to cover the work required by the production systems.

In the community under study, small-scale paid labor such as bijao leaf processing (66 %), fruit growing (67 %), and livestock farming (50 %) are carried out primarily by women. In Colombia, women's participation in the agricultural sector is through small-scale production, thus promoting the preservation of cultural traditions, food security, protection of natural resources, contribution to local markets and the country's economy (Farah and Pérez, 2003; Caicedo, 2016). Women also play a substantial role in sustaining agricultural systems aimed at self-consumption, such as the feeding of small farming species and family gardens.

Figure 2 show the time spent by women, men and children in various activities. While men and children are predominant in the areas of external labor and education, respectively, women overwhelmingly dominate both household work and the production of bijao.



**Figure 2.** Distribution of daily hours devoted to various activities by women, men and children.

The women spend about six hours on activities related to the household, caring for children and the elderly, cleaning the house and preparing food for the family and farm workers. According to studies by Chiappe (2005) and UNDP (2011), domestic work and family care are unpaid activities in which an estimated 93 % of rural women spend more than eight hours a day, compared to 60 % of men with three

hours. This information corroborates the results obtained for this study, as men spend only two hours engaged in unpaid activities – much less than the time spent by women.

Bijao promotes women's autonomy by allowing them to combine productive activities with household duties; whereas men spend most of their time on off-farm agricultural and construction activities. Men spend only two hours/day, unlike women who spend eight hours/day on bijao leaf work. This distribution of activities in the home preserves the role of women as the main transmitters of traditional knowledge.

Children of bijao producing families spend most of their time on their schooling (seven hours a day). However, on weekends or after school they engage in bijao-related activities. Including the young in agricultural activities generates a sense of cultural belonging and awareness of the opportunities they have to change their environment; they can contribute as a source of labor force and a repository of local knowledge, indispensable for the family unit (UNDP, 2011). It was found that children of peasant families have acquired the bijao process by being integrated through various small activities (mainly in the drying of the leaf), assuming responsibilities and becoming aware of the generational transfer of knowledge by considering the bijao as a source of income. Peasant youth migration is one of the main problems of rural areas in Latin America (Groedkoop, et al., 2004); therefore, incorporating children into leaf transformation activities contributes to reducing youth displacement to other areas.

Bijao leaf sales are made directly to the veleño bocadillo factories located in Moniquirá, Vélez and Barbosa municipalities or through intermediaries that buy at the markets or to producers' farms. Marketing is done in four ways: 1) standing, where the plants are sold to be cut (5.9 %); 2) green, where no processing has taken place (5.9 %); 3) white and deveined, when the vein has been cooked, dried and removed (76.5 %); and 4) white cut, where it is arranged and packed under the requirements of bocadillo producers (11.7 %); The latter is the only one that is sold directly in factories, so it garners the best price. However, 88.3 % of the bijao producers do not know how to cut the bijao leaf according to the Veleño bocadillo company standards, which is why they turn to the intermediaries.

The average weekly income per family that sell green bijao is 178.7 USD, and when the cost-benefit ratio is estimated, they receive an average weekly profit of 46.5 USD. Thus, families earn approximately US\$186.1 per month which is below the legal minimum wage in force in Colombia (US\$ 284,9 per month in 2020). The same situation is encountered for

68 % of the rural population in Colombia (Machado and Botello, 2014). Price fluctuation is the main problem during the buying and selling of the bijao leaves. In general, the commercialization of bijao leaf does not generate losses, but the profit depends on the degree of transformation of the leaf and all the intermediaries involved. Therefore, one of the challenges for bijao producers is price stabilization and improvement of the technical processes.

### Vegetation associated to bijao

The zone is between 1850 and 2000 meters above sea level with an annual temperature between 17 and 24°C and an annual rainfall of 500-1300 mm, characteristic of a premontane humid forest (bh-PM) which this occupies 5.3 % of the area of the department of Boyacá in the municipalities of Puerto Boyacá, Muzo, Coper, San José de Pare, Zetaquirá, Miraflores, Páez, Aquitania, Boavita, Soatá, Chita and Moniquirá (Corpoboyacá, 2015).

Taxonomic determination of different samples confirmed that the species present in the area is *Calathea lutea*, with a characteristic height between 2

and 3 meters, elongated stem, simple leaves, tubular inflorescence purple-red bract and yellow flowers (Maza and Builes, 2000; Cardona, Higuera and Hoyos 2010, 2010).

The presence of two subspecies was evidenced, differentiated by the color of the vein, white or purple; the first is more common, and the second is present in two plots due to a rougher texture, which makes processing difficult. For this reason, its distribution and propagation by villagers has been reduced, and it subsequently has found its singular purpose in landscaping. Nonetheless, the community states that the subspecies of purple vein bijao is more resistant to climatic conditions and could, therefore, be considered a reservoir of genetic diversity, needed for coping with climate change scenarios in the future.

A total of 41 plant species associated with bijao were identified (Table 1); most 27.6 % were ornamental; 22.4 % were used for food; 13.8 % are medicinal; 12.1 % are woody trees used as fuel; 6.9 % belong to trees used for construction; 5.2 % of the vegetation protects and maintains water sources; 8.6 % represents species used in handicrafts; and 3.4 % are

**Table 1. Vegetation associated with bijao and its uses.**

Uses	Vegetation
Food	Coffee ( <i>Coffea arabica</i> ), Banana ( <i>Musa</i> spp.), Guava ( <i>Psidium guajava</i> ), Citrus ( <i>Citrus</i> spp.), Avocado ( <i>Persea americana</i> ), Cassava ( <i>Manihot esculenta</i> ), Guamo mico tail ( <i>Inga codonantha</i> ), Wonder ( <i>Amaranthus</i> sp.), Bore ( <i>Alocasia macrorrhiza</i> ), Nispero ( <i>Eriobotrya japonica</i> ), Uchuva silvestre ( <i>Physalis angulata</i> ), Arracacha ( <i>Arracacia xanthorrhiza</i> ), Achira ( <i>Canna edulis</i> ).
Ornamental	Corozo palm ( <i>Aiphanes horrida</i> ), Spoon ( <i>Myrsine guianensis</i> ), Camomile ( <i>Euphorbia cotinifolia</i> ), Figue ( <i>Furcraea cubensis</i> and <i>F. gigantea</i> ), Wild iris ( <i>Iris</i> spp.), Coralito ( <i>Hamelia patens</i> ), Maravilla ( <i>Amaranthus</i> sp.), Nispero ( <i>Eriobotrya japonica</i> ), Acacia ( <i>Acacia</i> spp.), Acacia ( <i>Acacia</i> spp.), Weeping willow ( <i>Salix humboldtiana</i> var. <i>lloron</i> and var. <i>vela</i> ), Nazarene or carob ( <i>Hymenaea courbaril</i> ), Urapán or ash ( <i>Fraxinus chinensis</i> ), Achira ( <i>Canna edulis</i> ), Beard or old mane ( <i>Tillandsia usneoides</i> ), Heliconias ( <i>Heliconia</i> spp.), Quiches ( <i>Tillandsia</i> spp.) and bromeliads ( <i>Guzmania</i> spp.).
Building and Construction	Guadua ( <i>Guadua angustifolia</i> ), Urapán or ash ( <i>Fraxinus chinensis</i> ), Rubber ( <i>Ficus</i> spp.).
Fuel	Saithe or piscoquin ( <i>Albizia carbonaria</i> ), Arrayan or champo ( <i>Eugenia egensis</i> ), Guamo rabo de mico ( <i>Inga codonantha</i> ), Guacharaco ( <i>Cupania latifolia</i> ), Nazareno or Algarrobo ( <i>Hymenaea courbaril</i> ), Matapalos ( <i>Ficus dendrosida</i> ), Urapán or ash ( <i>Fraxinus chinensis</i> ), Tachuelo ( <i>Zanthoxylum rigidum</i> ).
Medicinal	Pigtail fern ( <i>Pteridium aquilinum</i> ), Chamomile close up ( <i>Euphorbia cotinifolia</i> ), Cordoncillo ( <i>Piper aduncum</i> ), Guamo monkey's tail ( <i>Inga codonantha</i> ), Broom ( <i>Sida rhombifolia</i> ), Water mother ( <i>Trichanthera gigantea</i> ), Wild uchuva ( <i>Physalis angulata</i> ), Old beard ( <i>Tillandsia usneoides</i> ).
Craftsmanship	Figue ( <i>Furcraea cubensis</i> and <i>F. gigantea</i> ), Enea ( <i>Typha angustifolia</i> ), Pink Cedar ( <i>Cedrela odorata</i> ), Rubber ( <i>Ficus</i> spp.), Wax laurel ( <i>Morella pubescens</i> ).
Protection of water sources	Enea ( <i>Typha angustifolia</i> ), Water mother ( <i>Trichanthera gigantea</i> ), Weeping willow ( <i>Salix humboldtiana</i> var. <i>lloron</i> and var. <i>vela</i> ).
Shady	Saithe or pisco ( <i>Albizia carbonaria</i> ).
Forage	Tumbabobos grass ( <i>Cynodon nlemfuensis</i> )

**Table 2. ES associated with bijao and recognized by the community (n=16 families).**

Types of ES	Ecosystem services	Valuation
<b>Regulation</b>	Water retention and conservation, protection of water bodies, soil cover, erosion prevention, soil conservation, temperature and microclimate regulation, air cleaning and purification	10
<b>Support</b>	Animal shelter, arthropod shelter as pollinators and natural enemies, and plant shelter	8
<b>Provision</b>	Bocadillo packaging.	10
<b>Cultural</b>	Cultural identity	9
<b>Average</b>		9,3

utilized for shade and fodder. Additionally, to community established uses, some herbaceous species, such as quiches (*Tillandsia* spp.) and bromeliads (*Guzmania* spp.), are important in the ecosystem because they generate organic matter, protect soils from erosion, and provide habitat and food for wildlife (Cogollo, et al., 2007).

#### **Community identification and assessment of ecosystem services associated to bijao areas**

Eleven ecosystem services (ES) were recognized and socially valued (Table 2) with an average score of 9.3 on a scale of 0 to 10 (10 > importance), indicating that the community recognizes the importance of the ES associated with the bijao to ensure subsistence and quality of life.

The ES associated with bijao are related to water, soil and microclimate, which depend directly on the diversity of the ecosystem and the high variety of species and the interactions that occur there (Groot, Wilson and Boumans, 2002). According to the farmers in the area, the bijao helps to conserve water and retains it when it rains. In addition, in the summer the leaves cover the soil, reducing the impact of the sun and wind on the surface, thus reducing water the evaporation of the resource, as well as protecting and feeding water bodies in the area by facilitating water infiltration and providing shade.

In the hydrological cycle, vegetation plays a fundamental role since it ensures water conservation (e.g. of rivers, streams and surface wells) (IDEAM 2015). The vertical arrangement of the bijao leaves, the abundant foliage and root area, are characteristics that allow a greater water uptake and drainage to the soil (Serrano, Regues and Nadal, 2012), helping to conserve water sources, even over the course of long droughts, by the microclimate generated by this plant system.

The soil-root interaction allows the bijao plant to conserve the soil mainly on slopes, retaining it by means of the tension of the root system and the mooring it has on the soil particles (FAO, 2000). In

Colombia, it is estimated that 40 % of the soil has eroded (IDEAM, 2015), and therefore, by acting as a cover that protects and prevents landslides, bijao is providing a tremendous service in preventing further erosion.

The use of dead cover improves soil properties (structure, texture, color, and porosity), reduces erosion, decreases particle compaction, increases water infiltration, and protects it from climatic factors (Jiménez and Añasco 2005). The vegetable residue generated from the cutting of the dry leaf and placed on the ground provides protection and cover, ensuring the conservation of humidity and the improvement of the soil structure.

All plant species play an essential role in the regulation of climate and air purification due to the photosynthetic process that captures carbon dioxide (CO<sub>2</sub>). Moreover, this ecosystem service is directly proportional to the photosynthetic efficiency of each of the plant species present in the ecosystem (Laterra, Jobbagy and Paruelo, 2010). The forests in the area not only offer benefits to the community through their use but also regulate the microclimate and purify the air. The bijao, due to its extensive leaf area (1m x 0.5m/leaf) on plants over 3m in height, offers shade and a cooler environment compared to low coverage pastures provides shade, microclimate and comfort for animals and people.

The community recognizes the areas associated with the bijao as habitat for beneficial arthropods such as bees and spiders, which take advantage of the plants to make their hives and webs. Insects and birds help to pollinate plants and crops that are found around them, as well as various types of wasps, hummingbirds and even bats (Cogollo, et al., 2007). It also provides habitat for amphibians, reptiles and birds which make their nests among the plants. Frogs and toads require high humidity conditions during their life cycle, in addition to arthropods as food (Suárez and Alzate 2014), which is why they are present in this system. The trophic chains that are formed are important in agroecosystems, as they help to control pests, diseases, weeds and maintain

beneficial species that are important for both agricultural production and people (Pérez and Marasas, 2013).

The bijao offer a service of provision and culture: the leaf of this plant has been transformed and used since the 16th century as a wrapper of the *veleño* bocadillo, a native product that has passed from generation to generation representing tradition and strong cultural roots in the country (Prada, et al., 2006; Peña and Muñoz, 2015) (Fig. 3). This leaf has also been used to wrap other traditional foods, to cover huts, to protect against rainfall due to its characteristic leaf size, and it provides a pleasant aroma and taste, allowing it to be used in traditional cooking (Díaz 2011).



**Figure 3.** Bocadillo Veleño wrapped in bijao leaf.

Agriculture can provide multiple functions in addition to the economic approach, including: guaranteeing food security and sovereignty, environmental conservation, and the preservation of cultural wealth, customs and traditions (Acevedo, 2016a; Acevedo, 2016b; Andersen, et al., 2013; Ayala and Garcia, 2009). The community associates bijao with multiple ecological functions, such as: the protection of water bodies, temperature and microclimate regulation, air purification, organic matter supply, erosion prevention, soil conservation, weed control, and shelter for amphibians and arthropods. Therefore, both in systems in which the leaves immersed in natural areas are used and in those in which they have been cultivated, their traditional management contributes not only to the obtaining of economic resources but also indirectly provides conservation values of natural and cultural resources by safeguarding regional tradition and identity.

#### **Analysis of socio-ecological relations in the areas associated to the bijao**

By analyzing the social cartography and comparing it with the historical maps of Google Earth (Fig. 4) available since 2009, it became evident that 20 years ago the forest areas near the water sources (rivers, streams) and within the farms were more extensive. Currently, the areas with the greatest amount of forest

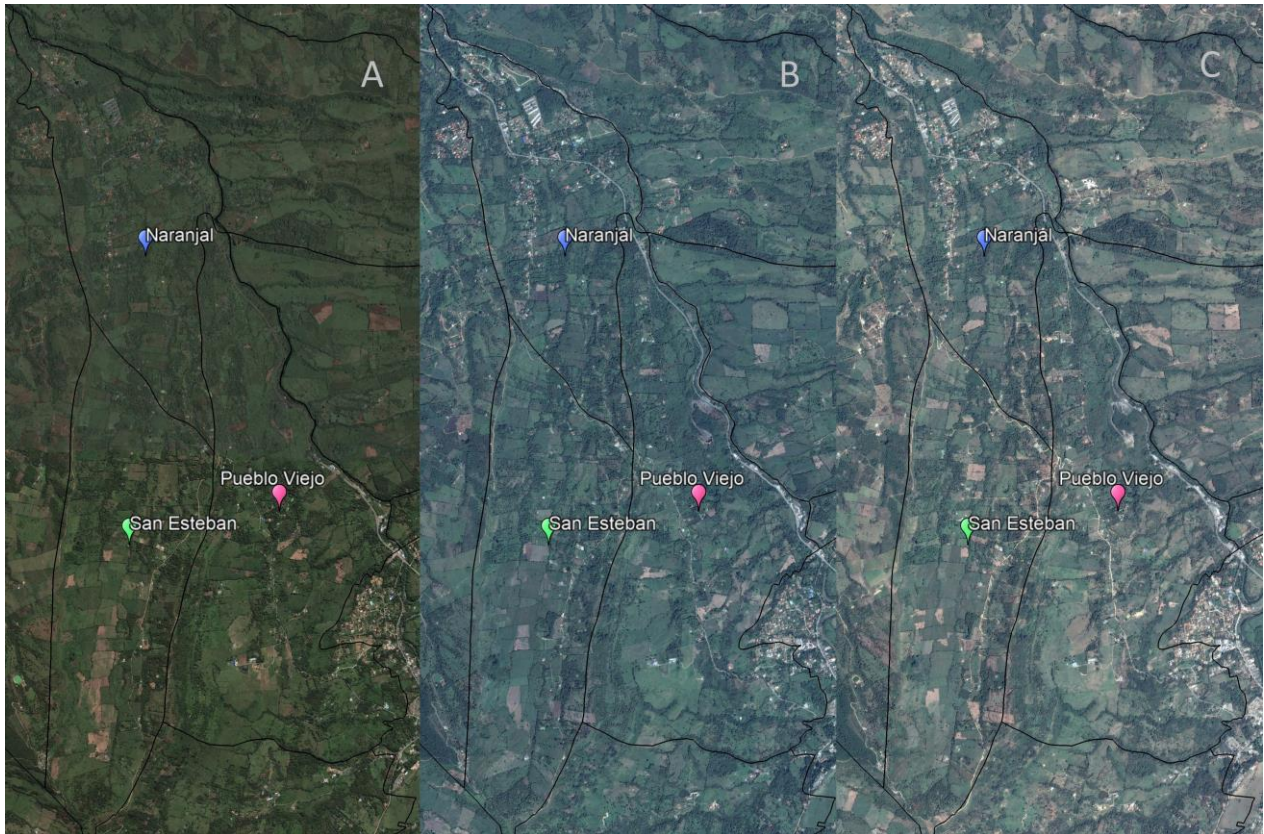
are associated with steep areas and within these, conflict zones prevail due to the expansion of the agricultural frontier and urbanization, causing the reduction of forest areas and the decrease in water availability and quality.

The construction of country houses, condominiums and recreation centers has increased in recent years due to the climate and improved road networks. Recreational and tourism activities have also intensified, to the detriment of woodland areas. Water bodies are being contaminated by the misuse of agrochemicals and the installation of septic tanks. In Colombia, the increase in water pollution and degradation is mainly due to domestic (26 %), agricultural (64 %) and industrial (10 %) activities, which causes a decline in water supply (IDEAM 2015).

At the present, the bijao can still be found on the margin of ravines that cross the area, coexisting with woody and shrub species present in the forest remnants or associated with polyculture of citrus fruits, bananas, guava, sugarcane, coffee, among others, creating an ecological connection that allows the movement of animals and the diversification of fauna and flora.

However, a comparison of the 1997 and 2017 maps constructed by the community showed an increase in the area under bijao cultivation, the result of a growing demand that shows a transition in its relationship with the ecosystem from being cut and used in non-planted systems or on farms associated with various plants with multiple uses to being in monoculture areas established with commercial interest. This implementation can have implications for the environment, such as the reduction of biodiversity, soil deterioration and the increase of pests and/or diseases.

Therefore, it is essential to establish actions that allow the welfare of the community and the conservation of forested areas, which are vulnerable to being replaced as a result of the expansion of the agricultural frontier of bijao and other crops, not to mention the increase in the commercial and tourism sector in the area. The farmers recognize the need to implement agro-ecological practices aimed at strengthening the production of crops such as bananas, coffee, sugar cane and fruit trees in areas where bijao is present, in order to reduce economic dependence on a single product, favoring food sovereignty and coexistence with the natural areas that are still present. The management of these systems may be accompanied by public or private institutions and may be aimed at environmental conservation, sustainable management of natural resources, preservation



**Figure 4.** Historical map of the area under study a) 2009, b) 2013 and c) 2016 (Google Earth, 2020).

of genetic diversity and diversification of plant and livestock species for both commercialization and self-consumption.

## CONCLUSIONS

Bijao is an ecosystem commodity that impacts human, social, economic, political, environmental and cultural aspects of the community. The predominant agriculture is family farming in transition, in contrast to most rural areas of Colombia where the predominant agriculture is subsistence farming. The bijao processing activity ensures some economic security for the families that process the product; however, it is necessary to attend to production and commercialization limitations, which are a strong challenge of the bocadillo agro-chain.

The bijao is part of the tradition, culture and historical memory of the inhabitants and families: it is part of their identity and promotes a sense of belonging to the territory. It represents a career opportunity for young people who are involved in the process from childhood, ensuring that the tradition lives on. It was also learned that bijao has strengthened the empowerment and autonomy of women, who are the basis for the transmission of knowledge. Therefore,

bijao represents a tool of resilience to problems such as the devaluation of women and the migration of young people.

The community relates the ecosystem where the bijao is located to the provision of eleven ecosystem services. The recognition of this ecological role promotes the values of natural resources conservation, important in an area where conflicts prevail between forest survival, agricultural production, urbanization, and tourism prevail, contributing to the preservation of natural and cultural resources, and contributing to the sustainability and maintenance of regional tradition and identity.

## Acknowledgements

The authors would like to thank the Corporación Universitaria Minuto de Dios (UNIMINUTO) for the financing of the project and the community of bijao's producers of the Province of Ricaurte in Boyacá - Colombia, who received, collaborated and accompanied us for more than two years in the development of the research..

**Funding.** This study was supported by Corporación Universitaria Minuto de Dios – UNIMINUTO. Bogotá. Colombia



**Conflict of interest statement.** The authors confirm that there are no known conflicts of interest associated with this publications.

**Compliance with ethical standards.** The research presents original data that are not submitted to other journals at the same time. All relevant permissions were obtained including those required by research participants, host communities, sponsoring institutions, or ethics committees.

**Data availability.** Data are available with the corresponding author at: (nhiguera@uniminuto.edu) upon reasonable request.

## REFERENCES

- Acevedo, A., 2016a. Monofuncionalidad, multifuncionalidad e hibridación de funciones de las agriculturas en la cuenca del río Guaguarco, sur del Tolima. *Revista Luna Azul*, 43, pp 251-285
- Acevedo, A., 2016b. Contribuciones y retos de la agricultura familiar en Colombia. In: A. Acevedo and J. Collazos, Eds. 2016. *La agricultura familiar en Colombia. Estudios de caso desde la multifuncionalidad y su aporte a la paz.* Universidad Cooperativa de Colombia, Corporación Universitaria Minuto de Dios and Agrosolidaria. pp. 31–45. <https://doi.org/http://dx.doi.org/10.16925/9789587600476>.
- Ayala-Ortiz, D. and R. García-Barrios., 2009. Contribuciones metodológicas para valorar la multifuncionalidad de la agricultura campesina en la Meseta Purépecha. *Economía, Sociedad y Territorio*, 9(31), 759-801. <http://www.scielo.org.mx/pdf/est/v9n31/v9n31a7.pdf>
- Andersen, P., Vejre, H., Dalgaard, T. and Brandt, J., 2013. An indicator-based method for quantifying farm multifunctionality. *Ecological Indicators*, 25, 166-179. <https://doi.org/10.1016/j.ecolind.2012.09.025>
- Caicedo, J., 2016. Seguridad Alimentaria y Nutricional: Experiencias con Huertas Rurales de la Comunidad Chapacual, Nariño. Fundación Suyusama. Pregraduated diss Pontificia Universidad Javeriana.
- Cardona, F., Higuera, D. and Hoyos, S., 2010. *Flora de la Miel: Central Hidroeléctrica Miel I, Oriente de Caldas: Guía ilustrada.* Medellín: Universidad de Antioquia.
- Chiappe, M. B., 2005. La situación de las mujeres rurales en la agricultura familiar en cinco países de América Latina. *Gloobalhoj* No. 6. [online] Available at: <https://library.aru.ac.uk/referencing/harvard.htm> [Accessed July 2017].
- Cogollo, A., Suárez, L., Robles, C., and Benítez, D., 2007. Identificación, caracterización del hábitat, conservación y uso de plantas de la familia Marantaceae en la jurisdicción de CORANTIOQUIA [PDF] Medellín: CORANTIOQUIA. Available at: [http://www.corantioquia.gov.co/ciadoc/FLORA/AIRNR\\_CN\\_7222\\_2006.pdf](http://www.corantioquia.gov.co/ciadoc/FLORA/AIRNR_CN_7222_2006.pdf) [Accessed June 2017].
- Corpoboyacá. 2015. Capitulo II: Elementos del Medio Natural. Atlas Geográfico y Ambiental (MADS). [PDF] Bogotá D.C., pp. 33 – 83. Available at: <https://www.corpoboyaca.gov.co/servicios-de-informacion/atlas-geografico-y-ambiental/> [Accessed June 2017].
- Díaz, S., 2011. Las hojas de las plantas como envoltura de alimento. [PDF] Bogotá D.C.: Ministerio de Cultura. Available at: <http://patrimonio.mincultura.gov.co/SiteAssets/Paginas/Publicaciones-biblioteca-cocinas/biblioteca%2014.pdf>. [Accessed June 2017].
- FAO, 2000. Manual on integrated soil management and conservation practices. . *Land and Water Bulletin.* [PDF] Roma. Available at: <http://www.fao.org/3/x4799e/x4799e.pdf>. [Accessed June 2017].
- FAO, 2014. *Agricultura Familiar en América Latina y el Caribe: Recomendaciones de Política*, S. Salcedo and L. Guzmán. Santiago, Eds. Chile: FAO. Available at: <http://www.fao.org/3/i3788s/i3788s.pdf>
- Farah, M. and Perez, E., 2003. Mujeres rurales y nueva ruralidad en Colombia. *Cuadernos de Desarrollo Rural*, (51), 137–160. <https://revistas.javeriana.edu.co/index.php/desarrolloRural/article/view/1275>
- Goedkoop, J., Roa, M., Sanz, J., Barahona, J. and Menéndez, J., 2004. Los jóvenes y la investigación: experiencias en Honduras y Colombia. *LEISA Revista de Agroecología*, 20 (1729–7419), 13–15. <http://leisa-al.org/web/images/stories/revistapdf/vol20n2.pdf>
- Groot, R., Wilson, M. and Boumans, R., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, 41(May), 1–20. [https://doi.org/10.1016/S0921-8009\(02\)00089-7](https://doi.org/10.1016/S0921-8009(02)00089-7)

- Google Earth, 2020. [Mapa de San Esteban, Naranjal y Pueblo Viejo en Monquirá en Google Earth] Accessed 6 de junio de 2020. <https://earth.google.com/web/@5.89146413,-73.59265158,1915.21094659a,5461.11745724d,35y,0h,0t,0r>
- Gutiérrez, H., 2002. Aproximación a un modelo para la evaluación de la vulnerabilidad de las coberturas vegetales de Colombia ante un posible cambio climático utilizando Sistemas de Información Geográfica SIG con énfasis en la vulnerabilidad de las coberturas nivel y de páramo. *Meteorología Colombiana*, 6(0124–6984), 55–63. <http://hdl.handle.net/20.500.12324/18925>
- IDEAM, 2015. Tomo II: Deforestación y afectación de los ecosistemas por ocupación del territorio y actividades económicas. Informe del estado del medio ambiente y los recursos naturales. Bogotá, D. C.
- Jiménez, W. and Añasco, A., 2005. Cultivo de coberturas y abonos verdes. Serie Agricultura Orgánica No. 8: Corporación Educativa para el Desarrollo Costarricense CEDECO. MAELA. Costa Rica [online]. Available at: [https://cedeco.or.cr/files/Abonos\\_verdes.pdf](https://cedeco.or.cr/files/Abonos_verdes.pdf). [Accessed June 2017].
- Jiménez, A. and Palacios, N., 2011. Plan de negocios para la creación de empresa “Bocadillos de mi Tierra Ltda.” Pregraduated diss., Universidad EAN. Bogotá D.C.
- León, J., 2000. Botánica de los cultivos tropicales, Turrialba: Editorial Agroamerica
- Laterra, P., Jobbagy, E. and Paruelo, J., 2010. Valoración de servicios ecosistémicos. Buenos Aires: INTA.
- Machado, A. y Botello, S. 2014. La Agricultura Familiar en Colombia. Serie Documentos de trabajo N° 146. Grupo de Trabajo: Desarrollo con Cohesión Territorial. Programa Cohesión [PDF]. Santiago: Rimisp. Available at: [http://portalsiget.net/ArchivosSIGET/recursos/Archivos/1682015\\_AgriculturaFamiliarC.pdf](http://portalsiget.net/ArchivosSIGET/recursos/Archivos/1682015_AgriculturaFamiliarC.pdf) [Accessed June 2017].
- Maletta, H., 2011. Tendencias y perspectivas de la Agricultura Familiar en América Latina. Documento de Trabajo N° 1. Proyecto Conocimiento y Cambio en Pobreza Rural y Desarrollo. [PDF]. Santiago: Rimisp. Available at: [http://www.rimisp.org/wp-content/files\\_mf/1366294106N902011AgriculturafamiliarAmericaLatinaMaletta.pdf](http://www.rimisp.org/wp-content/files_mf/1366294106N902011AgriculturafamiliarAmericaLatinaMaletta.pdf) [Accessed June 2017].
- Maza, V. and Builes, J., 2000. Heliconias de Antioquia: guía de identificación y cultivo. Medellín: Universidad de Antioquia
- Millennium Ecosystem Assessment, 2005. Ecosystems and human well-being: synthesis. Washington DC: Island Press.
- Ministerio de Ambiente y Desarrollo Sostenible and Programa de las Naciones Unidas para el Desarrollo, 2014. Quinto Informe Nacional de Biodiversidad de Colombia ante el Convenio de Diversidad Biológica. [PDF] Bogotá D.C.: Ministerio de Ambiente y Desarrollo Sostenible and PNUD. Available at: [https://www.minambiente.gov.co/images/sala-de-prensa/Documentos/2014/marzo/310314\\_v\\_informe\\_bio\\_colombia\\_070314.pdf](https://www.minambiente.gov.co/images/sala-de-prensa/Documentos/2014/marzo/310314_v_informe_bio_colombia_070314.pdf) [Accessed July 2017].
- Montaña, A., 2006. El bocadillo veleño. *Revista Semana*, [on line] Available at: <http://www.semana.com/especiales/articulo/el-bocadillo-veleno/79602-3> [Accessed July 2017].
- Peña, Y. and Muñoz, A., (2015). Importancia de la Denominación de Origen del bocadillo veleño en hoja de bijao como estrategia de diferenciación competitiva. Pregraduated diss. Universidad de la Salle, Bogotá D.C.
- Pérez, M. and Marasas, M., 2013. Servicios de regulación y prácticas de manejo: aportes para una horticultura de base agroecológica. *Revista Ecosistemas*, 22(1), 36–43. <https://doi.org/10.7818/re.2014.22-1.00>
- PNUD, 2011. Colombia rural: Razones para la esperanza. Informe Nacional de Desarrollo Humano 2011. [PDF] Bogotá. DC: PNUD. Available at: [http://www.co.undp.org/content/dam/colombia/docs/DesarrolloHumano/undp-co-ic\\_indh2011-parte1-2011.pdf](http://www.co.undp.org/content/dam/colombia/docs/DesarrolloHumano/undp-co-ic_indh2011-parte1-2011.pdf). [Accessed July 2017].
- Prada, L., García, H., Koop, E., and Cáceres, J., 2006. Bijao: un empaque para la Certificación de Origen del bocadillo veleño. Bogotá D.C: CORPOICA
- Rodríguez, J., Echeverría, C., Oyarzún, C. and Morales, L., 2017. Spatial congruence between biodiversity and ecosystem services in a forest landscape in southern Chile: basis for conservation planning. *Bosque*, vol. 38(3), pp. 495-506. <http://dx.doi.org/10.4067/S0717-92002017000300007>.
- Serrano, M., Regues, D. and Nadal, E., 2012. Translocación y escorrentía cortical en la

- cuenca experimental de San Salvador, Pirineo Central español. Cuaternario y Geomorfología, 26(1-2), 49-72.  
<http://hdl.handle.net/10261/58928>
- Sistema de Información sobre Biodiversidad de Colombia (SIBC), 2017. Biodiversidad en Cifras. Accessed. July 2017.  
<https://www.sibcolombia.net/biodiversidad-en-cifras/>
- Suárez, A. M. and Alzate, E., 2014. Guía Ilustrada Anfibios y reptiles Cañón del río Porce, Antioquia. Retrieved from [https://www.epm.com.co/site/Portals/Descargas/2015/rio\\_porce/Guia\\_Ilustrada\\_canon\\_del\\_rio\\_Porce\\_Antioquia\\_Anfibios\\_y\\_reptiles.pdf](https://www.epm.com.co/site/Portals/Descargas/2015/rio_porce/Guia_Ilustrada_canon_del_rio_Porce_Antioquia_Anfibios_y_reptiles.pdf)
- Superintendencia de Industria y comercio, 2017. Resolución N° 37563, Ref. Expediente N° SD2016/0056382
- Urquiza, A. and Cadenas, H., 2015. Sistemas socio-ecológicos: elementos teóricos y conceptuales para la discusión en torno a vulnerabilidad hídrica. L'Ordinaire des Amériques. <http://journals.openedition.org/ordea/1774>; DOI: 10.4000/ordea.1774
- Van Huylenbroeck, J., Calsyn, E., Van den Broeck, A., Denis, R and Dhooghe, E., 2018. *Calathea*. In: Ornamental Crops, Handbook of Plant Breeding. J. Van Huylenbroeck (ed.), Springer International Publishing AG, part of Springer Nature. Pg. 301 – 318