

Agrobiodiversity management in traditional high mountain orchard: Totoro indigenous reservation, Cauca - Colombia

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Abstract: The present work has the objective of documenting the diversity of species and crops and how these are managed and interchanged among different ecological floors through the traditional orchard in the context of the indigenous community of Totoro based on the conceptual-methodological elements of ethnobiology, as the scientific framework that studies the relations plants-humans and the different ways of handling plant resources in traditional agricultural systems (HERNANDEZ X., 1985) and the analysis of social media (JANSSEN et al., 2006). For this purpose, a design of qualitative analysis methods with ethnographic and ethnobotanical tools is performed. Following results stand out the description of the handling and complementary interchange among ecological floors of 68 plant species in traditional orchards; which allowed to identify which traditional orchards are key for the articulation of the networks for the interchange of knowledge, practices and vegetal material through the principles of reciprocity, redistribution and family relationships.

Keywords: Agrobiodiversity, Totoro, Traditional orchard, High Mountain

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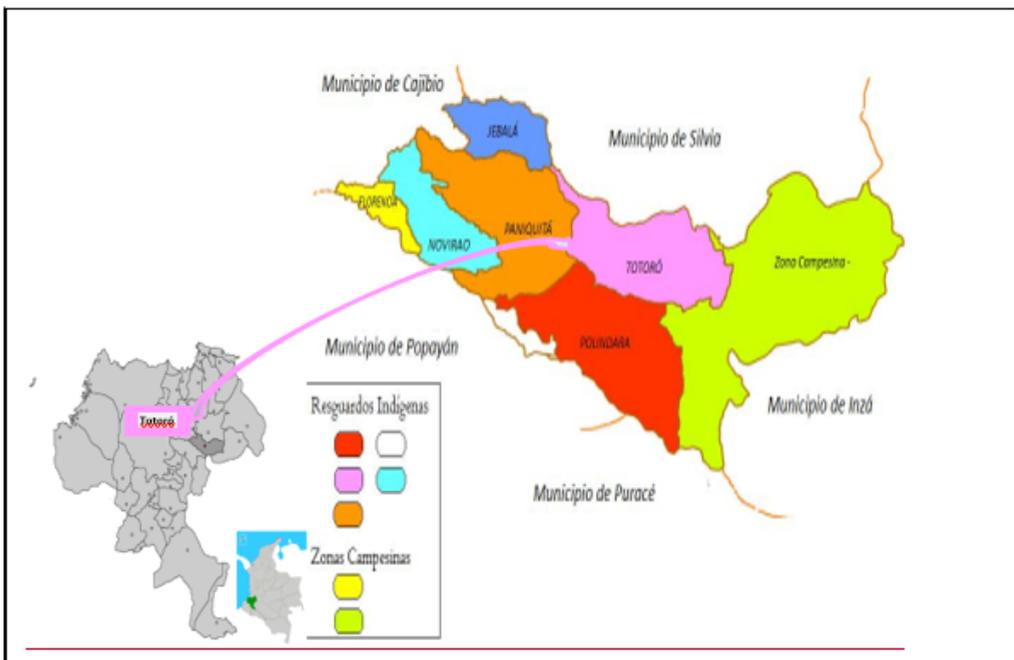
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Introduction

The indigenous groups of Totoro, located in Totoro, Cauca, South West region of Colombia, latitude $2^{\circ} 38'$ and longitude $76^{\circ} 19'$ (FERNANDEZ et al., 2008), is one of the most cultural and biological diverse zones in the country, with an indigenous population of 13.392 habitants, representing the 65,5% of the whole population on the opposite side the rural population 24,9%, 9,4% racial mixed people and 0,2% African Colombian people (DANE, 2005); It has as characteristic the ancient presence of: nasas, polindaras and tontotuna, distributed in 5 groups: Novirao and Jebalá, conformed by all the nasa indigenous group; Polindara, for the polindada indigenous people; Paniquitá y Totoro with the integration of tontotuna indigenous. (See figure 1 PDT, 2008)

Figure 1 –. Indigenous boundaries and reservations belonging to the municipality of Totoro, Cauca - Colombia



Source: PDT (2008)

The 13203 hectares of tontuna indigenous are distributed in thermal floors from the sub- Andean to the high moors, with temperatures between 0° to 22°C and annual precipitation of 1084 mm (CRC, 2015), the varied range of thermal floors this goes from 2200 to 3800 meters above sea level and the wiggly topography establishing a heterogenic, mountain relieves with larger biophysical and weather variations that creates a large ecological variety. The indigenous living here in high moors came from strong historical recovery and territory expansion process. (CAMELO, 2015).

The word *tontotuna* is the denomination of *nam trik* (native language) to talk about the Totoro people, taking into account the different expressions in Totoro, like *totoroes* that are not appropriated in their native language. This people called itself *tontotuna*, which came from an ancient place called *Salado Blanco*, where to big rocks in form of knees exist located in a hill: for this reason, the old people relation this and in *Nam Tik* language knee means fool hill means *tuna*, therefore their name is *tontotuna*. This place corresponded to a salt mine and a place where people interchange products between different indigenous groups. The Spanish conquerors named this place *Totoro*, because the indigenous could not pronounce the name *tontotuna*. (Plan de salvaguarda étnica y cultural del pueblo indígena *tontotuna*, 2008).

In the indigenous territory of *tontotuna* people, exists traditional agricultural practices and traditional cultural activities, characterized by the use of ground with ownership forms and ground uses practiced during centuries, which are a vivid expression of the indigenous people that leave in Andean zones towards particular relationships ways with the environment between the local ecosystems and cultural interventions, making progress and a good relationship with the environment.

In this way, the *tontotuna* authorities have been consolidating since the beginning of 90 is a drainage process in the reservation, demanding the indigenous autonomy, persistence and increasing the value of the territorial autonomy, their knowledge and traditional sociocultural ancestral practices in an ecological degradation and cultural lost (LEVA, 2008).

One of the main factors that allowed this recovery is the strengthening of traditional arch, in a coordinated work between the programs of the indigenous reservation of *totoro*, the environmental program, health program, communications, production, indigenous guard, education, and the guidance given by the document *Plan de Vida tutored, 2002 Recuperando y fortaleciendo nuestro pensamiento*". *Totoro, Cauca- Colombia*; Which has allowed and facilitated the monitoring of strategies and actions for managing agrobiodiversity based on ancestral knowledge and complemented with western plans and knowledge, within the framework of respect and reciprocity.

The characteristics of the traditional orchard highlight an agricultural system, a vital productive space represented by particular forms of land use, management of agrobiodiversity and relationship with the environment, its adaptation and transformation through experimentation, as well as by the transmission, socialization of agricultural practices and knowledge through relationship networks, all of this generated through centuries of interaction between ecosystems and species of useful plants, generally herbaceous and shrubby, highlighting vegetables, fruit trees, food, medicinal, ornamental; in addition, they include a great variety of species of perennial and, occasionally, annual plants, that its most notable feature is the vertical structure, which turns out to be a copy of the stratum of the high Andean high mountain forest.

In the living spaces of the indigenous territory, especially in the middle and high mountain areas, situations of deterioration in the conservation of plant resources have been occurring, through the implementation of technological modernization models, despite being an area that should be dedicated to the conservation of high moor ecosystems, considered unique,

very fragile, vulnerable and of great production of water sources by runoff for the country (IAVH, 2017) and genetics erosion defined are the genetically diversity and agrobiodiversity lost caused by cultural values changes as well as in the changes of the traditional productive system changes (SANABRIA, 2006), besides the weather changes, social and political external factors, non-proper use of ground, the increase in extraction activities that influences the availability of natural resources, the offer of environmental services and the continuity of various production systems closely related to local communities (IAVH, 2017).

In response to this problem, the totonotuna people, in their political-organizational dynamics and following the provisions of the life plan, the ethnic-cultural safeguard plan and the policy to strengthen their identity, determine as a priority the revitalization of ancestral production systems, in this case the traditional orchard as a physical and spiritual space that synthesizes the conception of the people in their relationship with nature as a source of life, sustenance, physical-spiritual health and an element of peaceful resistance that guarantees the people their survival in the territory. In this sense, increase the response capacity and risk minimization against the development of rained agriculture, climate variability and socioeconomic dynamics. (ALTIERI; NICHOLLS, 2013).

The orchards roll has been studied from different theoretical-methodological perspectives: Ethnobiology highlights the use and management of the biodiversity contained in orchard spaces based on local knowledge that characterizes them as an economic unit for self-consumption, an in situ genetic bank, and reflects the cultural identity of human groups in relationship to nature (GISPERT et al., 1993; ORJUELA, 2006; SANABRIA, 2001).

Agro ecology establishes the traditional orchard as and agroecosystem where its management procedures and use of variety of plants, animals and mushrooms are associated with their production and reproduction in a close relationship with the social conditions, economic and cultural in their domestic units and the generation and appropriations of technologies (MARIACA et al., 2007)

To analyse the links between function and structure in traditional gardens and correlate socio-environmental factors with cultural values through the exchange relationships of seeds, cultivated plants, knowledge and mobility of traditional gardens, the perspective of Social Network Analysis highlighted. ARS (WASSERMAN; FAUST, 2013).

However, related studies to processes of understanding and analysis of forms of management of agrobiodiversity in traditional orchards have been characterized by the exclusion of variables related to the specific conditions and practices of indigenous work in productive structures, and their relationship with the decision facing economical, ecological and social structure components; that means, the processes of description and analysis of how traditional knowledge forms a system, is generated, is transformed and interacts with elements of ecological and cultural diversity have not being tackle enough. (ORTIZ, 2013).

For this reason, through this research, we proposed to document local practices and sociocultural knowledge, describe management between ecological levels and analyse the

agrobiodiversity interrelationships between thermal floors and traditional high mountain orchards in the indigenous reservation context of totonotuna people, based on the conceptual and methodological frameworks of ethnobiology as an interdisciplinary science that studies interrelationships between humans and plants and ways for managing plant resources in traditional agricultural systems (HERNANDEZ X., 1985), analysis, social networks as a relational approach that allows the identification of elements and properties emerging from the dynamics of nature society in productive contexts (JANSSEN et al., 2006). In this way, we hope to contribute to strengthen the traditional orchard project than the Cabildo is promoting in the territory.

Starting with the ethnobiological concept as a scientific framework which studies the social systems indication and ecological attached dynamics (SAYLES et al., 2019), the natural appropriations (TOLEDO, 1991), methodological approach, socioeconomically relationships research focused of how to handle agrobiodiversity in tontotuna and its mechanisms of self-regulation of heterogeneous elements in crops regional systems in high Andean mountains in a concrete space with multiple sociocultural and agro economical called by tontotuna people traditional orchard. The results of social network (JANSSEN et al., 2006), focused on relationships allowed the identification of new characteristic, systematically elements and dynamics regulators in a natural society in ecological systems, interactions are fundamental (EKSTROM; & YOUNG, 2009).

Methodological tools designed for this research, corresponds to quantitative and qualitative analytical methods. The methodological descriptive and interdisciplinary quantitative approach (TAYLOR; BOGDAN, 1987) fundamental in derivative agronomy methods, geographical socioeconomically studies to stablish the functional qualities of traditional orchards and their socioeconomically relationships that influence in sociocultural and traditional knowledge to manage the agrobiodiversity in tontotuna territory: a) Recognition journeys using ethnobotanical cards (LAGOS-WITTE et al., 2011), which allowed to know specific aspects such as vegetable diversity, agroecosystems work, dynamic in rational orchards and others, b) surveys and prepared interviews (LÓPEZ; SANDOVAL, 2006), which enable to collect information related to traditional orchards, c) participatory action research workshops and meetings IAP (BORDA, 1999).

Quantitative analysis methods were built following the social network analytical method (CUMMING et al., 2010). The traditional orchard was tackled as adaptive management strategy of natural resources, which can be measured and analysed through the study of interrelationships between function and structure in socio-ecological relationships (PALACIO, 20017; MARSDEN, 2005). To identify the structure and connections types, the relationship between function and structure of traditional orchard in forms of production units' management in the indigenous reservation of tontotuna, to start from range, central and density indicators (BODIN et al., 2017).

Next, methods and tools applied to document the diversity of crop species, their varieties and management of agrobiodiversity between ecological levels in the traditional high-mountain orchard in the indigenous reservation are described:

1. Identification and selection of traditional orchards

50 units were selected and identified, taking into account social criteria, related to traditional orchard management and thermal floors (high, medium and low zone)

- Knowledge about the good use of agricultural practice and implemented them.
- Use of crops in traditional orchards for feed the families
- Increase diverse activities in traditional orchards (production and consumption)
- Land ownership
- Number of people in the territory
- Density of crops and agro diversity in traditional orchards.
- Cultural manifestations and rituals in the traditional orchards.
- Years of establishment in traditional arches
- Family relationships and number of people that integrate the indigenous group.

2. Journey to identify the vegetable resources available

Reconnaissance plant resources routs in traditional orchards were carried out, using ethnobotanical records (LAGOS-WITTE et al., 2011; SANABRIA, 2001) registering information and agroecosystems insisting with traditional agricultural technology according to management levels of plant species in each altitude zone (SANABRIA, 2006).

With the sponsor of maps, it was determined to travel with the participants, taking into account plant species of greatest interest to the local population, present in the traditional arches and different altitude levels (low, medium and high areas). The paths followed a logical analysis of vertical transects advancing perpendicular to the slope, observing plant species and evaluating beta biodiversity of cultural interest at an ecosystem scale (ANDERSON et al., 2011) and traditional orchard.

3. Make and implemented surveys

Making the survey complemented the variables established by authorities of the indigenous council and the present investigation aimed to identify socioeconomic, sociocultural and environmental characteristics of the farmers of the reservation.

The argumentation local process about the importance and effects of the traditional orchards, their forms of management of indigenous domestic production units, complemented with academic contributions on the management of agrobiodiversity in agroecosystems (GIAMPIETRO, 1997; GLIESSMAN, 2002), made possible to identify variables, which were classified into ecological, productive, environmental, economic and sociocultural dimensions (SEVILLA; & SOLER, 2010).

Ecological, environmental and product variations in household units

- Property Ownership
- What type of tillage is carried out (high impact, low impact, conservation)
- Use of agrochemicals (indiscriminate, moderate, without use)
- Area of the traditional orchards (of the total area of the property)
- Presence of crops (cultivated species)
- Knowledge and implementation of good agricultural practices
- Water protection
- Use of the orchards crops for feeding the family
- Use of timber products (quantity, species)
- Use of trees (timber, ornamental, water protection, fruit trees, erosion control)
- Management of seeds in the orchards (species, planting, exchange, sale)
- Activities related to self-consumption

Economic variables in the unit

- What do you produce in the crops, what products do you sell to obtain economic resources for the family soust?
- Activities related to sale agricultural products
- Activities related with the marketing of agricultural products

Sociocultural variables in the unit

- Number of people who live in the unit
- Number of people in the family who work in the crops
- Gender responsible for taking care of the crops
- Knowledge and interpretation of the agricultural calendar
- Knowledge of moments of the moon in relation to agriculture, breeding and handling of animals
- Why was this knowledge obtained regarding the agricultural calendar and moments of the moon
- Transmission of the knowledge to caring for crops with other community members or family
- Cultural practices and rituals in the crops
- Prepare Food
- What is produced in the garden, what crops are consumed to feed the family?

- Work Division

The survey was carried out in properties located in the villages of Santa Isabel, Malvaza and San Miguel in the upper zone of the reservation, properties located in the villages of Pedregal, La Peña and Betania in the middle zone and properties in the villages of las Vueltas and Miraflores in the lower area.

4. Methods to establish the management and exchange of agrobiodiversity between ecological floors through the traditional orchards

To analyse the links between function and structure of traditional orchards through exchange relationships of seeds, cultivated plants, knowledge and mobility of traditional orchards.

50 semi-structured interviews were done with people in charge of the traditional orchard work in 14 districts of the reservation, distributed as follows: 18 interviewees in the upper zone, 15 interviewees in the middle zone and 17 interviewees in the lower zone, taking into account the following variables:

Exchange of seeds from the traditional crops

- Knowledge transmission of who to take care of the traditional vegetable orchards with other units
- Knowledge Transmission regarding the seeds management from the traditional crops
- Mention of the unit - traditional crops with which it exchanges

To analysis data collected social networks, through the survey was coded in a matrix that records all the interviewed and referrals, composed by the number of connections between individuals and the variables that identify the sender and receiver of the seeds, knowledge and practices associated with how to cultivate and use each species. Descriptive statistics and social network analysis were performed using Cytoscape, version 3.6.1 (SHANNON et al., 2003). The traditional orchards were considered as node data, while the flows of seeds, varieties and knowledge between traditional orchards were treated as link data.

The measures described below were calculated to estimate the importance of households in the socio-ecological relationships of traditional orchards. The respective formulas for these measures are based on social network analysis (WASSERMAN; & FAUST, 2013).

Range: It allows to measure the maximum number of steps required to get from a node to any other node of the network. Related to access to knowledge, experiences or collective

memories.

- Density: Number of loops, divided by the number of network nodes. Related to the number of links in the network

Intermediation centre: The degree of intermediation or betweenness quantifies all the interaction paths and allows identifying the traditional orchards with greater influence in the management of network flows. A high intermediation value represents traditional orchards with greater indirect connections and those that play a central role in connecting network members.

- Degree of centrality: This measures the degree of connectivity of a traditional orchard with others in the network and allows establishing which is/are the most connected node (s). A high centrality value indicates that the sending node has a large number of direct connections compared to other nodes. This measurement can be applied to individual nodes or to the entire network. Centrality for the entire network (centralization) indicates the tendency for some factors to have many ties.

Results

Characteristics

Totoro corresponds to a region with an agricultural and environmental preservation vocation favoured by strengthening agroforestry systems; which large estates, smallholdings and communal lands interact, which generate a wide variety of agricultural products, from cold and medium climates, and sustain their economy mainly with potatoes production in the first line, with a 43.1% representation in the economy of Totoro and district of Gabriel López; followed by coffee crops, with 24% of production, in Alto and Bajo Palacé, Buenavista, Campo Alegre, Florencia, Jebalá, La Estela, La Primavera, Novirao, Paniquitá and Santa Ana; with less than 10% percent in Totoro with plots of less than 1 hectare, long onions, corn, bananas, ollucos-ullucos, cain, panela, vegetables, aromatic herbs and bread products are presented in Totoro on plots of less than 1 hectare, both for self-consumption and for the local and regional market (INCODER, 2013). In 2015, these percentages have been modified due to the arrival of the Ministry of Social Protection with the “IRACA” project, which works to strengthen traditional crops as a contribution to the life plan of the totoroez people.

Units – traditional orchards

The sociocultural, ecological and productive reality set where traditional orchards are groped highlights a system which unit members owned the land, here activities for self-consumption production predominate, there is implementation of sociocultural practices in the cycles productive, there is a high agrobiodiversity and diversification of activities for sustenance, complemented with a high degree of self-sufficiency energy of the unit.

Among the interviewed, the average number of members of the socio-productive unit was nine people; 82% of the families are nuclear and 12% extended, made up with three to five members. The surface of the traditional orchards ranged between 75 and 501 m², the average extension was 202 m². The average residence time on the property of the people interviewed in the three zones is 11 years and the average age of the owner is 58 years.

The maintenance of traditional orchards is carried out according to the following distribution: Parents are responsible for 22%, mothers for 38%, children for 16% and grandparents for 24%. The management practices recorded were: Soil preparation with a hoe in 89% and 11% with technical machinery; the conservation and management of seeds is carried out in 52% of the traditional orchards, which 78% are donated and obtained through exchange, in contrast to a minimum percentage of certified seeds; fertilization is carried out in 12% with chemical fertilizers and 82% with organic fertilizers; 78% of families know and implement the agricultural calendar; 34% of the families carry out harvest and post-harvest management under criteria of good agricultural practices and 66% establish traditional harvest and post-harvest management practices; 96% of the families participate in spaces for the exchange of “barter” products promoted by the production program of the indigenous council.

Traditional orchard is cultivated principal with root vegetables for self consuming like papa solanum tuberosum (Solanaceae), ulluco ullucus tuberosus (Basellaceae), majua (Oxalis tuberosa), oca oxalis tuberosa (Oxalidaceae) y arracacha (Apiaceae) with altitude 2000 a 3800 m.s.n.m.; cereals like corn 2000 a 3800 m.s.n.m.; identified for the local community like six year and six months, because this is the harvest duration, leguminous vegetables for self consumption like haba vicia faba (Fabaceae), chachafruto (Fabaceae) y frijol (Fabaceae), vegetables like mejicano (Cucurbita ficifolia), batata (Ipomoea batatas) and. zapallo (Cucurbitaceae), fruits like uchuva (Solanaceae), breva (Moraceae), granadilla (Passifloraceae), durazno (Rosaceae), feijoa (Myrtaceae). It predominates the majua-haba-oca-papa-haba, pasto-potatoe-garlic-barkey-broad been, potatoe-corn-beens-broad been, medicinal plants for self consumption like camomile, siempre viva, immediately alivio, mint, verdolaga, rosemary and ruda.

...”In the world of the traditional orchards, we find everything, I have six varieties of potato and five of ulluco, I own seeds, some of them are from the sowings that we do, because not all of them can be sold, because the seed purchased it's not like the one you grow. I sow alone, there are hineldo, fennel, white and purple oca, cilantro, purple arracacha, yellow arracacha, camomile, potatoes, arichosques for diabetic people and to lose weight in infusion you must put hot the water first, put the arichoque and leave it there for 20 minutes, do not boil water because it loses its essence and absinth, If you boil the plan its potency and energy died. I have the plants alegría, siempre viva, seguidora, dormideira or alegron de paramo and it is called by sibundoyes and ajo macho which is for men protection it you have someone making black magic. I also have white and purple cabbage, corn and all the varieties, I have all kinds of capio, its seeds

are very old and passed from generation to generation. I never buy that one...” Don Evelio ¹

Table 1 presents botanical information about agrobiodiversity resources present in the traditional orchards of the Totoro indigenous reservation, whose manifestation of diversity is represented in 68 variants of the different botanical families managed in the upper, middle and lower areas of the tontotuna territory.

Table 1 – Plant resources representative of the agrobiodiversity of the traditional orchards (high, medium and low zone) of the Totoro-Cauca indigenous reservation

Number of species*	Vegetal resource	Botanical family	Scientific name	Zone		
				High	Medium	Low
1	oca blanca	Oxalidaceae	<i>Oxalis tuberosum</i>	X		
2	oca roja	Oxalidaceae	<i>Oxalis tuberosum</i>	X		
3	oca morada	Oxalidaceae	<i>Oxalis sp</i>	X		
4	papa caluncha	Solanáceae	<i>Solanum andigenum</i>	X		
5	papa mora surco	Solanáceae	<i>Solanum sp</i>	X		
6	papa parda malvaceña	Solanáceae	<i>Solanum sp</i>	X		
7	papa careta o colorada	Solanáceae	<i>Solanum sp</i>	X		
8	papa yema de huevo o amarilla	Solanáceae	<i>Solanum sp</i>	X		
9	majua	Tropaeolaceae	<i>Tropaeolum tuberosum</i>	X		
10	ulluco rosado	Basellaceae	<i>Ullucus tuberosus</i>	X		
11	ulluco rojo	Basellaceae	<i>Ullucus tuberosus</i>	X		
12	ulluco blanco	Basellaceae	<i>Ullucus tuberosus</i>	X		
13	ulluco bola	Basellaceae	<i>Ullucus tuberosus</i>	X		
14	ulluco amarillo	Basellaceae	<i>Ullucus tuberosus</i>		X	
15	ulluco rosado	Basellaceae	<i>Ullucus tuberosus</i>		X	
16	maíz capio blanco	Poaceae	<i>Zea mays</i>	X	X	
17	maíz capio amarillo	Poaceae	<i>Zea mays</i>	X	X	
18	maíz capio pintado	Poaceae	<i>Zea mays</i>		X	
19	maíz amarillo	Poaceae	<i>Zea mays</i>	X	X	
20	maíz de año	Poaceae	<i>Zea mays</i>	X	X	

1 - Comunero-Cabildo del pueblo Totoro, vive en la Zona Alta-Pedregal. Trabaja en la Vereda Gallinazo, su finca está cerca del Rio Cofre.

21	maíz chiquito de seis meses	Poaceae	<i>Zea mays</i>	X	X	
22	maíz yucatan	Poaceae	<i>Zea mays</i>	X		
23	arveja piquinegra	Fabaceae	<i>Pisum sativum</i>	X	X	
24	arveja morada	Fabaceae	<i>Pisum sativum</i>	X		
25	frijol vara o cacha	Fabaceae	<i>Phaseolus vulgaris</i>	X		
26	frijol cacha blanco	Fabaceae	<i>Phaseolus vulgaris</i>		X	
27	frijol cacha morado	Fabaceae	<i>Phaseolus vulgaris</i>		X	
28	frijol cacha amarillo	Fabaceae	<i>Phaseolus vulgaris</i>		X	
29	frijol pintado de año	Fabaceae	<i>Phaseolus vulgaris</i>		X	
30	frijol pintado	Fabaceae	<i>Phaseolus vulgaris</i>		X	
31	mejicano-mexicano	Cucurbitaceae	<i>Cucurbita ficifolia</i>	X		X
32	arracacha amarilla	Apiaceae	<i>Arracacia xanthorrhiza</i>	X		
33	arracacha morada	Apiaceae	<i>Arracacia sp</i>	X		
34	arracacha blanca	Apiaceae	<i>Arracacia sp</i>	X		
35	haba blanca	Fabaceae	<i>Vicia faba</i>	X		
36	haba morada	Fabaceae	<i>Vicia faba</i>	X		
37	trigo peló	Poaceae	<i>Triticum aestivum</i>	X	X	X
38	trigo peludo	Poaceae	<i>Triticum aestivum</i>	X		X
39	col verde	Brassicaceae	<i>Brassica sp</i>	X		
40	col morada	Brassicaceae	<i>Brassica sp</i>	X		
41	repollo morado	Brassicaceae	<i>Brassica sp</i>	X		
42	repollo blanco	Brassicaceae	<i>Brassica sp</i>	X		
43	rábano	Brassicaceae	<i>Raphanus sativus</i>	X		
44	cebolla colorada	Amaryllidaceae	<i>Allium cepa</i>	X		
45	cebolla blanca	Amaryllidaceae	<i>Allium cepa</i>	X		
46	cebolleta morada	Amaryllidaceae	<i>Allium cepa</i>	X		
47	ajo blanco	Liliaceae	<i>Allium sativum</i>	X		
48	ajo morado o pate' perro	Liliaceae	<i>Allium sativum</i>	X		
49	espinaca común	Amaranthaceae	<i>Spinacia oleracea</i>	X		
50	jiquima	Fabaceae	<i>Pachyrhizus tuberosus</i>	X	X	
51	batata morada	Convolvulaceae	<i>Ipomoea batatas</i>		X	X
52	batata blanca	Convolvulaceae	<i>Ipomoea batatas</i>		X	X

53	mejicano	Cucurbitaceae	<i>Cucurbita sp</i>	X	
54	cidrapapa	Cucurbitaceae	<i>Sechium sp</i>	X	X
55	zapallo	Cucurbitaceae	<i>Cucurbita maxima</i>		X
56	chachafruto	Fabaceae	<i>Erythrina edulis</i>		X
57	cebada	Poaceae	<i>Hordeum vulgare</i>		X
58	lenteja	Fabaceae	<i>Lens culinaris</i>		X
59	garbanzo	Fabaceae	<i>Cicer arietinum</i>		X
60	manzana pequeña	Rosaceae	<i>Malus domestica</i>		X
61	mora de castilla	Rosaceae	<i>Morus nigra</i>		X
62	durazno	Rosaceae	<i>Prunus persica</i>		X
63	tomate de árbol	Solanaceae	<i>Solanum betaceum</i>		X
64	uchuva	Solanaceae	<i>Physalis peruviana</i>		X
65	breva	Moraceae	<i>Ficus carica</i>		X
66	granadilla	Passifloraceae	<i>Passiflora ligularis</i>		X
67	higuillo	Caricaceae	<i>Vasconcellea pubescens</i>		X
68	feijoa	Myrtaceae	<i>Acca sellowiana</i>		X

Source: The authors, field trip 2017-1018.

Table 1 lists three zones with their respective agricultural production systems: High zone, from 3,000 to 3,800 meters above sea level with extensive, technician agricultural systems, mechanized agriculture on relatively flat medium-depth soils, with good drainage. Of the 21 veredas, 10 of these produce potatoes, peas, ulluco, onions that complement economically with extensive dual-purpose livestock.

On the middle zone, between 2,500 and 3,000 meters above sea level, there is an agro environmental production model through polyculture of smallholdings greater variety, which combines organic agriculture with technician agriculture on hillside soils with steeper slopes. Beans, corn, potatoes, ulluco, peas, onions, arracacha, and aromatics are grown there as a commercial crop par excellence, which are merchandised in the city of Cali and Popayán. In the lower zone, between 2,000 and 2,500 meters above sea level, there is smallholding agriculture, with a warm climate on semi-undulating hillside soils, complemented by crops of corn, beans, coffee, cane, cassava, banana, fruit trees and vegetables. And agro-industrial crops of pine and eucalyptus, or asparagus, and monocultures of coffee and fique.

According to the field work research, approximately 50% of the families keep the seeds in their orchards (see figure 2), 10% are donated through exchange, the remaining percentage is dedicated them to technician crops such as potato and strawberry production; the seeds purchase is associated with the use of agrochemicals and the mechanical production practices. In 2015, the community members who make part to the different areas of the Tontotuna territory have been increasingly strengthening the strategy of the traditional orchards based

on the life plan of the Tontotuna people and the support offered mainly by the IRACA project, which until 2019, it has managed to link itself in economic, environmental, health and improvement aspects of the orchards, achieving an approximately 90% of the families strengthen their orchards, within this percentage, 30% of the families, exchange their seeds for plant variability purposes, thus achieving greater benefits of food security, family sustenance, spaces for the exchange of traditional knowledge and survival over the years.

Figure 2 – Traditional orchards (a) (b) (c) agriculture (d) Totoro, Cauca



Source: The authors (2017)

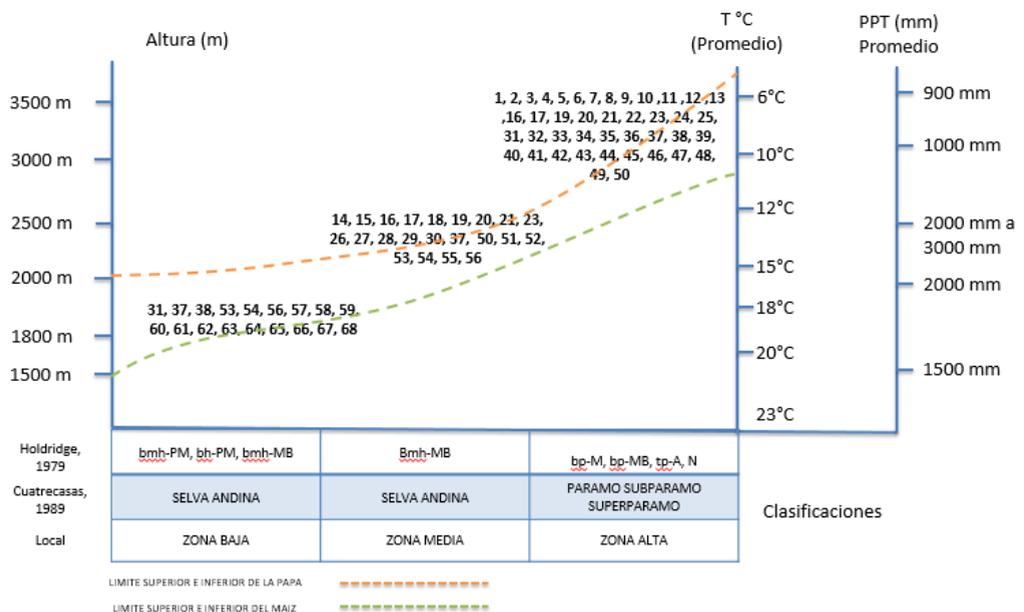
Strengthening traditional orchards is a community job that keeps being promoted in the indigenous tontotuna people, it represents 3% of the sovereignty alimentary strategy proposed by national rural development institution Incoder, which action field begins in small towns, 51.7% of this people are not land owners and 32% have less than 1 hectare, PDT (2008-2011).

Altitudinal distribution of crops in the Totoro Indigenous Reservation

According to SANABRIA (2001) result researches and altitude in high Indian Totoro region, the group crops are distributed in a range of 2.200 3.400 meters above sea level in

three vegetable groups or three life zones. In high area, 41 plant species are distinguished from the 68 presented in the traditional orchards visited, being the area with the greatest variety of cultivated plant species, as is the case of different types of potatoes called in Spanish papa caluncha, papa mora surco, papa parda malvaceña, papa careta o colorada, papa yema de huevo o amarilla careta o colorada, papa yema de huevo o amarilla; el ulluco rosado, ulluco rojo, ulluco blanco, ulluco bola, ulluco amarillo, ulluco rosado; y el maíz capio blanco, maíz capio amarillo, maíz capio pintado, maíz amarillo, maíz de año, maíz chiquito de seis meses y maíz yucatan also found in médium zone and it is a well preserved resource and with the best altitude; this contributes to strength traditional orchards. In middle zone we have frijol vara o cacha, frijol cacha blanco, frijol cacha morado, frijol cacha amarillo, frijol pintado de año y el frijol pintado as the may resouce presented in this crops and a total of 22 species wich do not varied as in the high and medium high zones. See figure 3

Figure 3 – . Altitudinal Crops distribution in indigenous reservation of Totoro. Modified off Sanabria (2001)



Source: The authors (2018). Modified of Sanabria (2001). The numbers in table 2 represent the vegetables in table 1.

In figure 3, the plant resources represent the agrobiodiversity of traditional orchards in the upper, middle and lower areas of the Totoro-Cauca indigenous reservation are listed, according to the numbering indicated in Table 1. The cultivated plants are indicated. By zones, which are managed in relation to the traditional orchards associated with the cultivation of

corn, potatoes, beans and ulluco.

The main factors that affect the selection and definition of agricultural areas in Totoro indigenous reservation are thermal floors (SANABRIA, 2001). In this way, management is carried out through the complementary use of resources, such as corn, beans, potatoes and ulluco, through the changes of traditional orchards and the social exchange of products through family relationships.

Changes of traditional orchards as mechanism to management agrobiodiversity in Totoro indigenous reservation based on the information collected through the survey on 50 traditional orchards of indigenous reservation, an analysis of social network was carried out. The mobility network of traditional orchards is made up of 50 community members from the indigenous reservation mentioned during the interviews, and has 96 mobilities. The characterization of traditional orchards, members of the socioecological network through the analysis of special measures, indicates a free distribution scale. This distribution allows us to establish that network shows an asymmetric and hierarchical behaviour, this means, that the largest number of nodes are not well connected, while there are few nodes that are well connected.

The mobility network of traditional orchards obtained by analysing the social network is presented in Figure 4 (a), and represents a graphic based on the intermediation and centrality degree, where each node indicates a crop space, the colour represents differences in each zone, according to the local classification of altitudinal floors in totoro indigenous reservation; the node size represents the intermediation and connection degree, the larger diameter ones are more important as nodes, since they are connected to a greater number of network members.

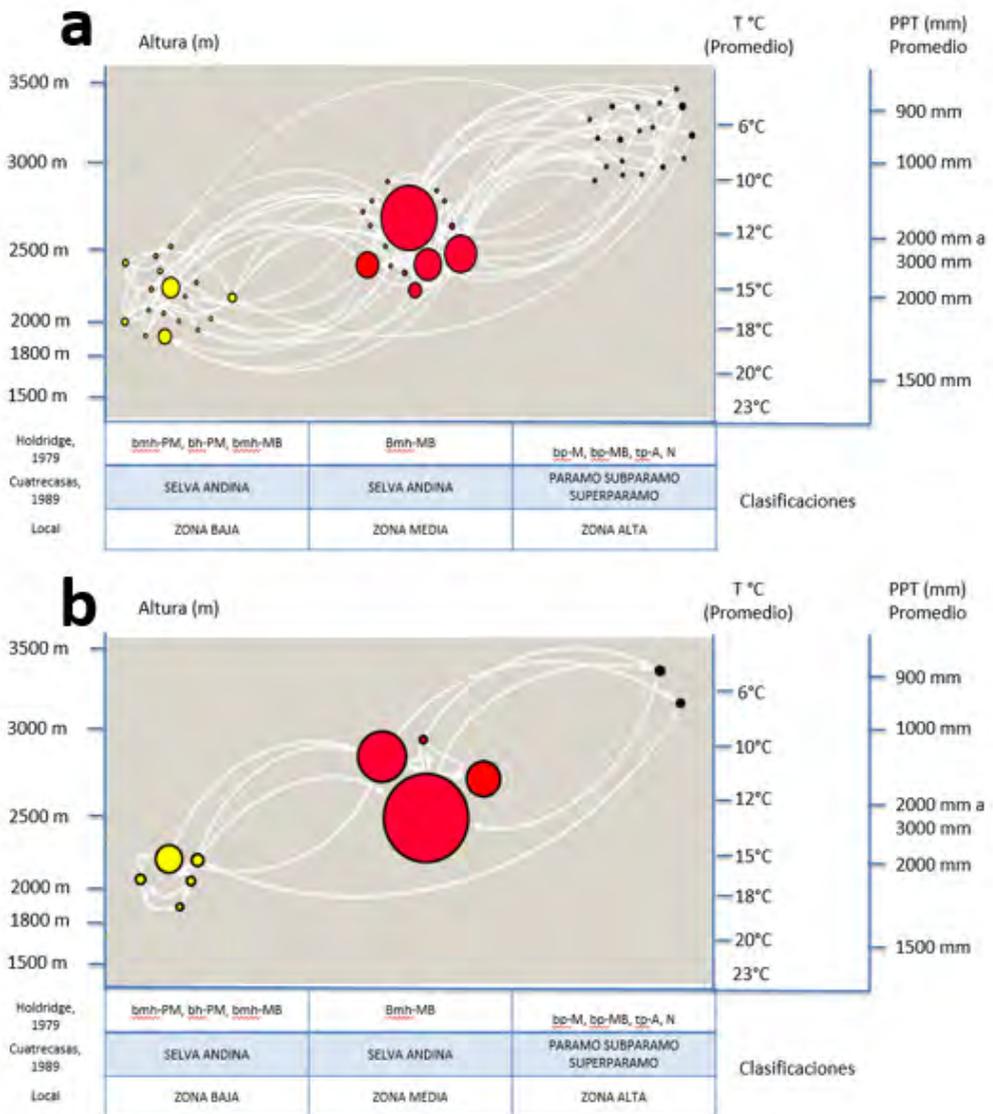
It is observed that Family relationships, reciprocity and redistribution predominate and the largest number of orchards (19) show little mobility (2 – 3 movements), while a smaller number of orchards show high mobility - see Figure 4 (a). The largest number of traditional crops tend to move at least 3 times in the different life zones, as indicated on figure 4 (a).

Eleven traditional orchards that highlighted their mobility network were found, characterized by presenting the largest number of movements in the traditional establishment of orchards and the exchange of seeds, agricultural products in one year; families that have a greater volume of interconnections, exchanges practices and knowledge associated with agricultural activity define these. Similarly, they represent high values betweenness degree measures and degree of centrality.

In outstanding farmers network, it is observed that traditional crops that presents the largest node size (H:12) has the highest intermediation degree value and high number of connections. On the other hand, the crops with the highest number of connections does not present the highest degree of intermediation (H:2).

Figure 4 (b) shows the structure of the network and the measurements obtained in the graphic analysis for the eleven orchards highlighted in the network.

Figure 4 –. Altitudinal distribution and mobility of traditional orchards in the Totoro indigenous reserve (a) - Traditional orchards highlighted in the mobility network (b)



Source: The authors 2017-2018

Considering centrality measures, in degree and betweenness, two nodes (TM1 and TM2) with (direct) links where more than nine members of the network were found. These traditional orchards are nodal centres with a high level of connection and importance for the

plants flow varieties and seeds, as well as the orchard mobility, they are located in the middle zone, with a residence time in the property of more than 10 years, with a low number of members of the unit (between 3 and 5 people), the areas destined for the vegetable crops are less than 500 m² and the owners age is in the oldest range of all the members of the network (between 53 and 68 years).

Discussion and Conclusions

Tontotuna people, guided by the approaches of their own government and ethnic safeguard plan, which defines its main objective “to strengthen and develop the exercise of autonomy and authority in accordance with the life plan for permanence and survival, as native people”, carry out various activities every day to preserve the dynamic balance between the social being and nature, and their living spaces. Traditional orchards and their dynamics of interaction in three thermal floors, like management strategies and conservation of agrobiodiversity, and strengthening of cultural practices, reinforce the capacity of the tontotuna indigenous community to face environmental, sociocultural and economic transformations.

By analysing social network, it was possible to identify eleven (11) nodes or traditional crops with a greater number of links and degrees of intermediation, represented knowledge articulating axes and exchange of, practices, plant material that identify indigenous peoples. These links highlighting socioeconomic and cultural importance of traditional orchards, guaranteeing the persistence of the traditional agricultural system, based on a subsistence economy in the ecological and sociocultural context of the tontotuna territory.

Traditional orchard of indigenous totonotuna’s people reservation is emerging as an economic variable, ecological regulating axis, and a specialized component of the domestic production units, since it allows the system sustainability within the limits imposed by the ecological and economic environment. The latter coincides what was established by SANABRIA (2001), in relation to the corn thesis as the articulating axis of historical and socioeconomic changes and variations in the near region of tierradentro, department of Cauca.

Social network analysis made possible to visualize the mobility dynamics of traditional orchards and identification of factors that emerge from socio-ecological interactions, which deserve to be recognized and preserved for their biocultural value. In this sense, cultural relations are strengthened through exchange networks through the traditional cultivation of corn and tubers in crops. Therefore, in order to establish processes of cultural strengthening and revitalization, traditional orchards and related families that present a higher degree of intermediation and centrality should be considered, since they have a greater practices exchanges flow and knowledge, and a greater connection within the network. This coincides with the approaches of ORJUELA (2006), who defines the orchard as a symbolic, cultural and family space that allows the reproduction of culture, of ancestral knowledge, the strengthening of identity and conservation of territory through Management and mobility of plants, considered as elements of culture, in the reservation of pueblo nuevo, Caldono.

The traditional orchard management units highlighted in the interaction network represent virtuous elements of the socio-ecological management relationships, diversification and conservation of agrobiodiversity and germplasm in Totoro indigenous reservation, represented through a large number of connections and based on the transmission of knowledge and practices based on a subsistence economy under principles of reciprocity, and strengthening cultural processes for the survival of indigenous peoples; practice taking place in the tontotuna people and also, in most of the ancestral local people at the regional, national and even world level.

The importance traditional orchards interactions between in 3 thermal floors as a management and conservation strategy for agrobiodiversity in the Totoro indigenous reservation is: i) biological, therefore it represents an important flow of genetic material and maintenance of seed exchange systems crops with genetic diversity and germplasm conservation; ii) socioeconomic, since it directly influences the diversification of self-consumption agricultural activities, the sale of agricultural and livestock products, and the sale work; iii) ecological, therefore it allows the agrobiodiversity-germplasm flow and connection between agroecosystems of the upper and lower zones. iv) cultural, as a strategy for coupling heterogeneous elements, conservation, exchange of knowledge and practices associated with agricultural activity through socio-ecological networks.

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Gestão da Agrobiodiversidade na horta de Alta Montaña Tradicional: Resguardo Totoró, Cauca – Colômbia

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Resumo: O presente trabalho tem como objetivo documentar a diversidade de espécies e variedades de culturas, seu manejo e intercâmbio entre pisos ecológicos através da horta tradicional no contexto da reserva Indígena Totoró com base nos elementos conceituais-metodológicos da etnobiologia, como o arcabouço científico que estuda as inter-relações entre humanos-plantas e formas de gestão dos recursos vegetais em sistemas agrícolas tradicionais (HERNANDEZ X., 1985) e a análise de redes sociais (JANSSEN et al., 2006). Para isso, foi realizado um delineamento de métodos de análise qualitativa com ferramentas etnográficas e etnobotânicas. Como resultados, destacam-se o manejo complementar e troca entre pisos ecológicos de 68 espécies vegetais em jardins tradicionais; isso permitiu, a partir da análise das redes sociais, identificar os pomares tradicionais que representam eixos articuladores da rede de troca de saberes, práticas e materiais vegetais por meio de relações de parentesco, reciprocidade e redistribuição.v

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Palavras-chave: Agro biodiversidade, Totoró, Horta Tradicional, Alta Montanha.

Manejo de agrobiodiversidad en la huerta tradicional de alta montaña: Resguardo Totoró, Cauca - Colombia

William Andrés Galvis Sarria
Martha Lucia Ordoñez Serna
Olga Lucia Sanabria Diago

Resumen: El presente trabajo tiene como objetivo documentar la diversidad de especies y variedades de cultivos, su manejo e intercambio entre pisos ecológicos a través de la huerta tradicional en el contexto del resguardo indígena de Totoró con base en los elementos conceptuales-metodológicos de la etnobiología, como el marco científico que estudia inter-relaciones humano-plantas y formas de manejo de los recursos vegetales en sistemas agrícolas tradicionales (HERNANDEZ X., 1985) y el análisis de redes sociales (JANSSEN et al., 2006). Como resultados se destacan el manejo e intercambio complementario entre pisos ecológicos de 68 especies vegetales en huertas tradicionales; lo cual permitió a partir del análisis de redes sociales identificar las huertas tradicionales que representan ejes articuladores de la red de intercambio de conocimientos, prácticas y material vegetal mediante las relaciones de parentesco, reciprocidad y redistribución

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