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ORIGINAL PAPER

Traditional forest-related knowledge and agrobiodiversity preservation: the case of the *chagras* in the Indigenous Reserve of Monochoa (Colombia)

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Abstract
Chagras are complex agroforestry systems developed by indigenous populations of the Amazon region based on shifting agriculture, as part of a system that includes harvesting of wild fruits and plants, hunting and fishing. During the centuries, thanks to their traditional knowledge, indigenous populations have developed a deep relationship with the surrounding environment, as, living in remote places, they must be self-sufficient. The result is the *chagra*, a system whose cycle is based on seven basic steps to establish a successful and sustainable system, starting from place selection and ending with the abandonment of the plot after harvesting of the products. After the abandonment, the forest starts to grow again to allow the agroecosystem to recover and to take advantage of the residual vegetal material to avoid erosion. The paper takes into consideration the Indigenous Reserve of Monochoa in Colombia as an example of how traditional knowledge can support a rich biodiversity conservation. Moreover, differently from other parts of the world where there is a growing contrast between indigenous communities and protected areas, in the Indigenous Reserve of Monochoa local communities have been recognized as the owners of the land. Results highlighted the crucial role of the indigenous communities for biodiversity conservation. The preservation and adaptation of traditional knowledge and practices, a decentralized autonomous governance system demonstrates that local communities not only can be part of ecosystems with unique biodiversity, but that they can represent the main actors for an active conservation of biodiversity. Agroforestry systems based on traditional forest-related knowledge can therefore be an effective alternative to biodiversity and ecosystem services conservation based on strict nature protection where humans are perceived as a negative factor.

Keywords Traditional knowledge · Sustainable rainforest management · Chagra · Agrobiodiversity · Agroforestry

Communicated by Mauro Agnoletti.

This article belongs to the Topical Collection: Biodiversity exploitation and use.

Introduction

Tropical forests all over the world have been affected by large-scale deforestation at very high rates in the last decades, with negative effects on biodiversity (Giam 2017). This trend also affected the Amazon, a region playing a crucial role concerning environment, biodiversity and water regulation (Ramírez 2012). The huge area called Amazon is not only home to natural environments and crucial for biodiversity at global level, but it is also the home of different indigenous populations that have developed a complex integrated relationship with the surrounding environment. They have adapted their traditional practices in order to obtain a wide variety of products and ecosystem services from the rainforests, without overexploiting their crucial resources, modifying the natural basis and creating landscapes shaped by culture (Agnoletti 2014). One of the most interesting practices is related to shifting cultivations, the most common traditional productive practice in the Amazon region (Coomes et al. 2017; Padoch and Pinedo-Vásquez 2010; Junqueira et al. 2016), and in particular to the agroforestry systems called *chagras*.

Chagras are a complex of different activities related to agroforestry practices, carried out by local indigenous communities in the Amazon area, shared by different South American Countries, and have been defined as "a polyculture mode, in appearance simple, around which the other productive activities of the indigenous population revolve, but that implies a management of time, space and cultural identity that increases the system complexity" (Triana-Moreno et al. 2016). These agroforestry systems are characterized by a huge agrobiodiversity, as a result of the traditional practices carried out by indigenous populations (Garavito et al. 2021). *Chagras* are not just related to agroforestry practices, but are part of an integrated system that includes horticulture, hunting, fruit harvesting and fishing. All these sustainable interrelations (ecosystemic, social and spiritual) are possible thanks to the knowledge and practices that are specific to women and men, in a complementary and interdependent way (GAIA Amazonas 2019a, b). Amazonian *chagras* are the place of conservation of many endemic species of flora, characterized by an exceptionally high diversity. About 2000 of them are used by local populations as food, medicine or for other purposes (Ramírez 2012).

At international level, in the last few years, there is an increasing interest in the biodiversity related to traditional agro-silvo-pastoral activities, that nowadays is considered as important as the biodiversity related to natural environments. This kind of biodiversity can be defined as biocultural diversity, a general term including agrobiodiversity, that is closely related to the preservation of these practices without which it is destined to decrease or even disappear (Agnoletti and Rotherham 2015). The Food and Agriculture Organization (FAO) defines biocultural diversity in the preamble of the GIAHS criteria, while agrobiodiversity is defined as "the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fibre, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production" (Food and Agriculture Organization 1999).

Chagras are one of the best examples of the synergies between the communities and their environments, being an ancestral system, which has been kept alive for millennia by surviving a lot of historical phenomena of the country (Uruburu-Gilède and Ortiz-Nova 2016). Starting from evangelization in the time of conquest to the rubber industry in the beginning of the twentieth century, and modern conflicts such as hunting for obtaining wild

animal skins for fashion industry, logging, mining, armed conflict, and drug trafficking, *chagras* have demonstrated an extraordinary capacity of resilience overcoming all these events and keeping alive the legacy of the indigenous communities to the present day. In particular, the evangelization and the development of the rubber industry, caused social and cultural collapse at large scale, which led to the extinction of different clans and to the demographic decline of many Amazonian indigenous ethnic groups (Instituto Amazónico de Investigaciones Científicas—SINCHI 2017).

The Indigenous Reserve of Monochoa, in Colombia, has a particularity because it belongs to a part of the Amazon which has been titled as a subject of rights by the Colombian government. This is a very important goal achieved by the local communities and it is the first time in the region that an ecosystem gets this kind of legal recognition. According to this, the Supreme Justice Court of Colombia, through the judgment number STC 4360-2018 in 2018 declared *that* "the Colombian Amazon is recognized as an entity subject of rights, holder of the protection, conservation, maintenance and restoration by the State and the territorial entities that make it up" *(*Corte Suprema de Justicia 2018, our translation).

The Amazonian *chagras* in Colombia are therefore different from the other ones in the region. First of all, Colombian Amazon is titled as subject of rights, and secondly the territory of the Indigenous Reserves of Monochoa is autonomous, that means that the local indigenous communities have been recognized as the owners of the land, with the possibility to establish their own laws according to their traditions, in respect of national laws. Moreover, in Monochoa women have a crucial role in the agricultural system, as a result of historic processes. In fact, in the past, the large landowners of rubber industry used to take the men of the indigenous communities to forced labour in their crops, so only women often remained in the community. This is why they learnt about seeds and how to combine the species, keeping alive the traditional knowledge of the Chagras, by assuming the responsibility of the crops production, and establishing in this way, the belief of the woman as a symbol of abundance.

The paper aims to highlight the connections between traditional agroforestry practices and local biodiversity conservation, providing a deep analysis of the local traditional knowledge related to Chagras and of the resulting agrobiodiversity. The agrobiodiversity linked to the presence of indigenous communities, is an important part of biocultural diversity and can be crucial for the conservation of biodiversity of natural rainforests. Furthermore, if properly managed, the relation between natural areas and local communities can bring significant benefits: local communities not only can cohabit in ecosystems with unique animal and plant species in the world, but they can represent the main actor for an active conservation of biodiversity.

Study area, materials and methods

The study area corresponds to the Indigenous Reserve of Monochoa, that is located between the municipalities of Solano (Caquetá Department) and Puerto Santander (Amazon Department), in south Colombia, on the two banks of the Caquetá river (Fig. 1). 8% of the territory is classified as *chagras*, that are mainly located in the dense forest along the river, that also represent the main transport and communication route; this is the best place for cultivating cassava (*Manihot esculenta*), the most relevant agrobiodiversity product of the system. 72% of the area is classified as dense forest, corresponding to areas with vegetation characterized by a more or less continuous stratum, with tree cover more than

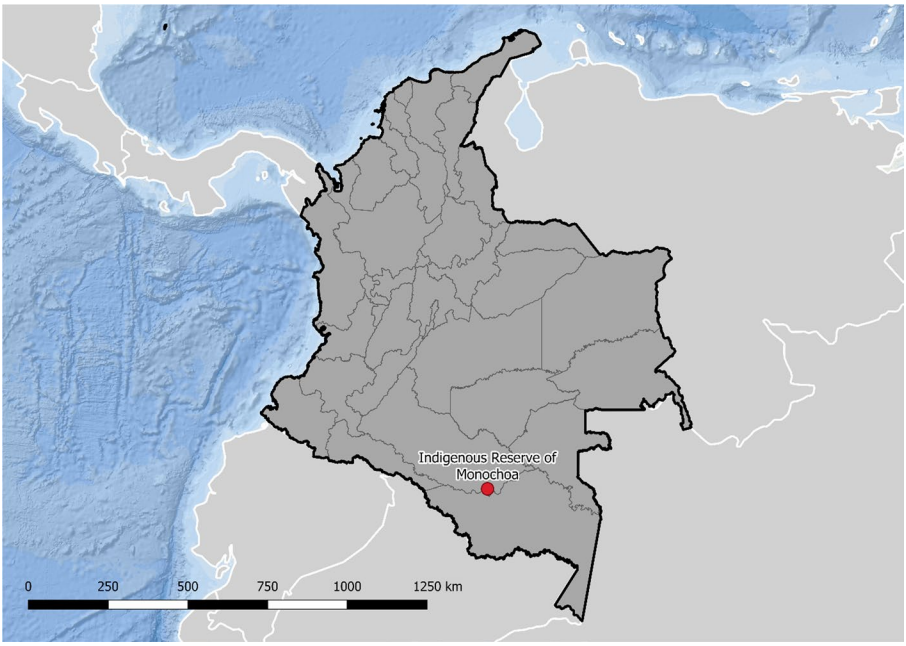

Fig. 1 The study area of the Indigenous Reserve of Monochoa is located along the Caquetá River, between the Caquetá Department and the Amazon Department, in south Colombia

70%, canopy height greater than 15 m and which is located in areas that do not have periodic flooding processes (Gobernación del Caqueta, 2012). 17% of the surface is covered by dense grassland, constituted by naturally developed herbaceous species, forming a dense coverage (> 70%); human intervention on these plant formations has been absent or very limited and has not altered the original structure or its functional characteristics (Gobernación del Caqueta 2012). Finally, the remaining 3% of the land corresponds to dense heterogeneous high flood forest, which corresponds to areas with vegetation characterized by a more or less continuous coverage (more than 70%), canopy height > 15 m and located in the fringes adjacent to the bodies of water, which correspond mainly to the plains subjected to periodical floods lasting more than two months (Gobernación del Caqueta 2012).

According to the Köppen-Geiger climate classification, the local climate is classified as *Af—Equatorial rainforest, fully humid* (Kottek et al. 2006), with an annual average range of temperature between 22 and 25 °C and a relative humidity that can reach values up to 82%. The annual rainfall has a rate of more or less 3500 mm, with two well distinguished seasons, the dry one from November to March, and the wet season from April to October. The altitude of the area reaches 500 m a.s.l.

There are approximately 239 people (60% men, 40% women) grouped in 45 families living in the Reserve, characterized by a higher age-frequency distribution in the class between 10 and 19 years old. According to the Instituto Amazónico de Investigaciones Científicas—SINCHI (2017), the population of Monochoa Reserve consists of 92.1% indigenous people, 7.1% *mestizo* population and 0.8% foreigners. In the territory there are two main indigenous groups: *Huitoto* who are the majority with 44% of the population, and the *Muiname* who represent 39% of the population. The rest of the indigenous population

is composed of minor ethnic groups as a result of the ethnic exchanges in the formation of families.

The present study is based on the investigation of the relation between the traditional practices of *chagras* and the resulting agrobiodiversity. From a methodological point of view the following steps were undertaken. A detailed analysis of the *chagra* system and of the related agro-silvo practices was carried out to offer a framework of the deep traditional knowledge and of the effects on the environment. This analysis was conducted in two steps, first of all by an assessment of the agrobiodiversity of the *chagras* through a deep bibliographic survey, and second one deepening the different species and varieties cultivated by the two main ethnic groups of the Indigenous Reserve of Monochoa.

Results

The *chagras* systems

Chagras are complex agroforestry systems, and even if they follow common principles, they have a variability according to the traditions of the different ethnic groups and to the environmental conditions. The establishment of these systems requires a deep traditional knowledge about soil, water, plants, fruits, animals and in general all the features present in the rainforest, in order not to overexploit the resources and to guarantee the sustainability of the system. Traditional practices related to *chagras* result in a rich agrobiodiversity. This agrobiodiversity is handed down from generation to generation and is particularly important for the preservation of germplasm, as indigenous families use the best fruits of the last harvest as new seeds for the next crops. Thus, in general one of the bases for the right functioning of the *chagra* is to have a great variety of different crops, selecting and sowing the seeds that have better production and quality. In addition, other useful species not directly sown or planted by humans are left growing in the *chagra*. The process of selecting and sowing the most productive varieties as well as preserving different species and varieties is also a way to establish and preserve a huge bank of local varieties germoplasm (Instituto Amazónico de Investigaciones Científicas—SINCHI 2011).

In the Colombian Amazon, the selections made by indigenous peoples in tuberous, cereals and fruits, based on practices and beliefs, resulted in the existence of approximately 400 genetic varieties, among which stand out cassava (*Manihot esculenta*), pineapple (*Ananas comosus*) and peach palm (*Bactris gasipaes*) (Arguello 1988). Though the establishment of *chagras*, indigenous people replicate the natural life cycle, as the *chagra* is based on the following seven basic steps (Fig. 2), that correspond to the ecologic calendar made by the indigenous communities according to a wider and complex system based on the different seasons which is the base of ecologic balance and cosmic equilibrium (GAIA Amazonas 2019a, b):

1. Place selection, negotiation and healing;
2. *Socola* and *tumba*;
3. Burning;
4. Planting;
5. Weeding and care of the *chagra*;
6. Harvest;
7. Abandonment and restitution.

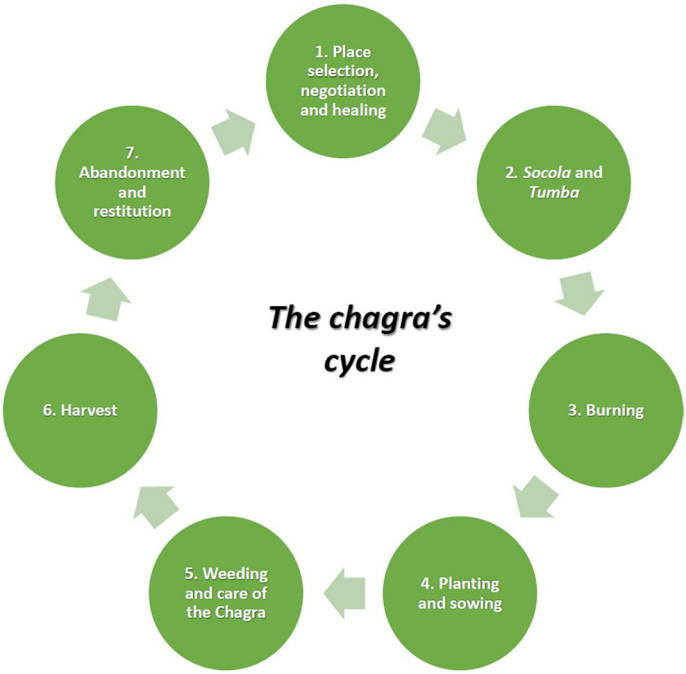

Fig. 2 The cycle of the *chagra*

(1) Place selection, negotiation and healing

According to the traditional social organization, this is a men's task as it is his responsibility to decide where the system is going to be settled. Men choose the suitable place for establishing the *chagra* evaluating different environmental features, especially in relation to the soil (depth, color, mud and/or sand content, non-muddy soils) (Cabrera 2004). Although the soil is the principal element to consider, climate conditions are also taken into account, especially in relation to the annual cycle of humidity and droughts typical of the region (La Rotta 1982). Since *chagras* are agroforestry units managed at familiar level, they must be located at a suitable distance from the family house but also not too distant from the Maloca, an abode in a broad sense, being a temple, but also the location of the religious power in the community. Crops must be close to the Maloca since the selected plot has to be blessed by the shaman in order to heal the territory and to ensure the abundance and quality of the harvest. Moreover, *chagras* do not normally occupy continuous places, but they are mainly scattered inside the dense forest (Van der Hammen 1992). After the choice of the place, as the real owners of the land are considered to be the spirits, it is necessary to negotiate with them in order to receive the permission to cultivate the land. The negotiation is made by the shaman, who offers coca and tobacco to the spirits who own the place, in order to receive the permit. This step is particularly important, as without this permit indigenous people believe that family members can face diseases or accidents (Instituto Amazónico de Investigaciones Científicas—SINCHI 2011).

(2) Socola and tumba

The second step is called *socola* and consists of cutting down all the lower layers of vegetation to obtain space for the agricultural crops. This labor is made by the men of the families and it is particularly important for the transmission of traditional knowledge, as during this step young people are taught the name of each tree, together with its traditional use (Román 2007). After the *socola*, the bigger trees are cut with the help of all members of the community (this process is called *tumba*). This is a social moment, also because the *minga* (set of neighbours who do the communitarian work) is summoned. The *Minga* constitutes a huge bond of fraternity and friendship among ethnic families and is a fundamental part of the social organization (Van der Hammen 1992). About 5–6 h with the participation of eight men are necessary for the establishment of 1 hectare of *chagra* (Briñez 2002). When the working day is over, the *minga* comes back to the village, where they are expected by the women in order to celebrate a fest called *Guarapiada* which owes its name from the typical alcoholic beverage of the indigenous: Guarapo.

(3) Burning

This is the first step in which women are directly involved. Even though from the operational point of view this process is simple, from the ritual side it is very demanding. In fact, "a newly burned terrain is considered hot and poisonous. Therefore, before planting it requires a detoxification and cooling process, otherwise seeds would burn instead of sprouting (Van der Hammen 1992). Two or three months after cutting down the trees, once the resulting material has dried, local families start to burn it, and after that they can begin with the cleaning of the *chagra*. This process is also crucial from the ecological point of view, as the burned material is used as a fertilizer, in particular for the more demanding products (tobacco, yota, yam) (Vélez and Vélez 1992). Moreover, after the burning of the vegetal materials, women perform a ritual to consecrate the land, mixing white yarumo leaves with the ashes and speading them throughout the *chagra* for ensuring a good yield of the crops (Román 2007). This last practice is made by the owner of the land and his wife together, as it symbolizes the birth, the life cycle, and with their union they fecund and give life to the *chagra*.

(4) Planting and sowing

Planting usually occurs in March, at the beginning of the rainy season, at least 10 days after the burning in order to wait for the soil to get cold and to wash the ash with the first rains to fertilize it. Sowing is done by the women, as they are considered the center of abundance and reproduction, with the help of men that are in charge of other agronomic works and of preparing *Mambe* (a powder made from coca leaves and other plants) and *Ambil* (a black paste obtained from cooked tobacco leaves, then mixed with plant salts) in order to bless other people who help the family (because sometimes it is necessary to summon the Minga) and also to heal the required vegetal material (Instituto Amazónico de Investigaciones Científicas—SINCHI 2017). Sometimes relatives and neighbours participate in sowing and planting, and later they will be rewarded with a part of the products of the *chagra*, as the work belongs to everyone and is for everyone (Schroder et al. 1987).

Planting and sowing of crops are anticipated by prayers for abundance and by the sown of the mother plants to strength the crops; after that, local people choose the crops which they are going to combine.

This phase is particularly important for the agrobiodiversity of the system, as it includes the choice of the species and varieties to use in the *chagra*. According to Schroder et al. (1987), the choice of the plants depends on the following seven criteria: (1) soil characteristics; (2) species of sorrounding forest, as these will be replaced by their counterparts of *chagra*, for example wild guamo is replaced by guamo of *chagra*; (3) aim of the *chagra* (self-consumption, commercialization, urgent need for some crops); (4) dietary habits of the families; (5) historical-cultural factors (different ethnicities sow different species and varieties); (6) short-term personal and/or family circumstances; (7) availability of seeds. These seven criteria are the ones which ensure the agrobiodiversity in the Indigenous Reserve of Monochoa and the resilience of the system. In fact, even if indigenous people cut down some wild species during the *socola*, they recover them sowing counterparts of varieties that have been adapted in order to produce in the *chagra*, replicating the rainforest system due to the synergic relations built between the species.

(5) Weeding and care of the *chagra*

This step is mainly the task of women, as they have more knowledge about the management of the yields according to their species and cultivation time. Therefore, this phase is the counterpart of the Socola and Tumba, because in this step women have the responsibility of weeding, while men are in charge of bringing the protein to the table by hunting or fishing, evidencing once again that this system only works from the complementarity of roles in the family. In the productive cycle of the system, there are four moments when the *chagra* has to be weeded: (1) 20 days after the sowing; (2) between the third and the sixth month after planting; (3) when *chagras* are about to be harvested between the sixth and the eighth month; (4) during the production of the *chagra* between the months eight to eighteen (Instituto Amazónico de Investigaciones Científicas—SINCHI 2011). This process is important not only to guarantee the adequate development of the crops, but it also has deep implications in terms of ecosystem services, as the regular maintenance of the *chagra* has an impact on the future regeneration of the forest (Garzón and Macuritofe 1992).

(6) Harvest

For the indigenous community of Monochoa, the mother of all the crops is the cassava. So, when "she" is ready to be harvested, local people know that the *chagra* is mature; even if other species have already reached their point of maturation, local people consider a *chagra* in productive status only when cassava is ready, and they do not collect any other product before cassava. Regarding this, Van der Hammen (1992) explains that the first product in chronological order that could be harvested is coca, however, a *chagra* is only considered in production when the first cassavas are ready to harvest. Thus, the cycle of the cassava becomes the ruling cycle for the *chagra*, also because cassava has the capacity of remaining underground and can be preserved in the soil for a long time without suffering any damage. In each *chagra* at least two types of cassava are cultivated: sweet cassava, which is suitable for direct human consumption, and wild yucca, a poisonous variety that has to be treated by women to extract the toxins before human consumption (Briñez 2002) (Fig. 3).

Fig. 3 Wild yucca and sweet cassava (Source: Food and Agriculture Organization 2018)

Other species, such as pineapple or coca grow next to cassava. They are known as transient crops, because their useful life is 2 or 3 years, and families are used to collect and storage as much as they need during this period. When the production of these species has finished, a new phase for the *chagra* begins: the harvest time of the fruits. The production of fruit trees changes the dynamics and the management of *chagra*, that turns into a real agroforestry system, with the fruit trees that become the most important crops. Fruit trees are in fact multipurpose trees as, beside fruits for human consumption, they provide fodder for animals and fiber for handcrafts. Moreover, fruit production is distributed throughout the year. After the first 3–4 years of the *chagra* establishment, some trees with a life cycle that can last approximately up to 15 years start to produce fruits, including amazon grape (*Pourouma cecropiifolia*), caimo (*Pouteria caimito*) and peach palm (*Bactris gasipaes*); after that, between the fourth and sixth year, begins the production of trees whose production periods last more than 30 years, including guacure (*Poraqueiba sericea*), cashew (*Anacardium occidentale*) and ucuye (*Macoubea guianensis*) (Vélez and Vélez 1992).

(7) Abandonment and restitution

After some years, higher fruit trees grow enough to cover the cassava plants that does not receive enough sunlight anymore, and in this way, stopping the cycle of the *mother crop*, the *chagra´*s cycle is over too. From the agricultural point of view, the abandonment of a *chagra* is caused by two reasons; the first one is due to the weeds and shrubs that have recolonized the area and that need to be eliminated, which implies more work than opening a new *chagra*; The second one is the level of nutrients in the soil that start to decrease with a subsequent reduction of the crops productivity (Instituto Amazónico de Investigaciones Científicas—SINCHI 2011). *Chagra* starts to get wild and the forest species start to recolonize the area. This process can last even for 25 years to complete the restitution's cycle, and during this period the family owner of the *chagra* keeps collecting some fruits. Soil fertility is the crucial factor for *chagras*, and it starts again to increase right after a continuous herbaceous pioneer species cover has formed. During the first 4–5 years it is possible to observe an increase in the humid layer, after which primary tree species begin to recolonize the area and the pioneer herbaceous species start to disappear (Walschburger 1987).

The agrobiodiversity of the *chagras*

During the last decades, some species have been lost, and nowadays about 75 cultivated species can be found in Colombian *chagras* and a total of about 300 ecotypes. Variations in shape, size, color, taste and production occur within each species, and are the result of adaptations to different environments and cultural requirements of each ethnic group. According to Vélez (2007) the crops with the highest intra-specific diversity are *yuca brava* (*Manihot esculenta*) with 56 varieties, sweet yucca (*Manihot esculenta*) (20 varieties), chili pepper (*Capsicum annum*) (27 varieties), pineapple (*Ananas comosus*) (35 varieties), guacure (*Poraqueiba sericea*) (20 varieties), peach palm (*Bactris gasipaes*) (13 varieties) and arrowleaf elephant's ears (*Xanthosoma sagittifolium*) (eight varieties).

Many different traditional varieties do not have a scientific classification but are well known among the indigenous populations, and the fact that there is a lack in scientific recognition can represent a threat for their preservation. In this paper we have used the scientific name of the species, the common name in Spanish, and the indigenous name of the varieties, according to the terms used by the two main ethnic groups: Muiname and Huitoto. Table S1 reports all the species and varieties identified in the Indigenous Reserve of Monochoa.

In the Indigenous Reserve of Monochoa, 132 different varieties of species harvested heve been identified regarding the Uitoto ethnic group and 131 different varieties related to the Muiname ethnic group. In both ethnic groups, cassava, coca and tobacco are the main crops. In the case of the cassava, the *mother* of the *chagra*, both Huitotos and Muinames use to cultivate 18 different varieties, of which four varieties have been classified as local ecotypes that are only produced in this place of the world. There is also one local ecotype of coca, called *"q + ícue jibieña"* in Huitoto or *"gaño meku"* in Muiname. This product has a very important spiritual meaning because it represents the main ingredient for Mambe, which is used to communicate with the creator of life. Coca is so significant as local people relate the main branch with the vertebral column of the creator and its fruits with his heart (Instituto Amazónico de Investigaciones Científicas—SINCHI 2017).

The Indigenous Reserve of Monochoa is important not only because of the rich agrobiodiversity, but also for the traditional use of these plants. Beside food production, in fact, many of these plants are used to provide wood, fibre and mostly medicines. For example, the arrowleaf elephant's ear *(Xanthosoma sagittifolium)* is used to heal fever and cough, the Barbasco is useful to treat flu and the Yagé is used to connect a person with his/her spirit to obtain details about the origin of the illness and how to treat it (Instituto Amazónico de Investigaciones Científicas—SINCHI 2017).

Comparing the crops of Muiname and Huitoto (Table 1), is possible to find out that for both groups perennial fruit trees is a typology with a high diversity of varieties, that in the case of the Huitotos is 22.9% of the total harvest, while for the Muinames represents 29.3% of their crops, mainly belonging to *Poraqueiba sericea*, followed by *Bactris gasipaes* and *Inga* spp., but including 18 different species. This can be explained due to the fact that fruit trees are particularly important for their diet since their maturation is gradual throughout the year. Muiname also cultivate a wide diversity of transient fruit trees, especially of *Ananas comosus* and of *Musa paradisiaca*. It is also important to mention that Huitotos have a really high number of plant varieties used for medical purposes or with sacred value, among which a large number could not be classified.

Table 1 Comparison between the varieties of the two main ethnic groups of the Reserve of Monochoa

	Muiname		Huitoto	
	Number of varieties	Percentage of varieties (%)	Number of varieties	Percentage of varieties (%)
Cassavas	18	15.5	18	13.7
Perennial fruit trees	34	29.3	30	22.9
Transient fruit trees	27	23.3	21	16.0
Vegetables	11	9.5	12	9.2
Chili peppers	17	14.7	17	13.0
Medicinal and special use plants	13	11.2	34	26.0
Total	116	100	131	100

Discussion

The Amazon region in 2018, through a decision of the Colombian Supreme Court of Justice, was recognized as an "entity subject of rights, holder of the protection, conservation, maintenance and restoration by the State and the territorial entities that make it up" (Corte Suprema de Justicia 2018, our translation). This recognition represents a great advance at global level regarding the legislative matter, also because it is a recognition of the role of indigenous ethnic groups living in the Amazon for the preservation of these crucial ecosystems. Moreover, the Reserve of Monochoa is considered a collective property created to guarantee the living space of indigenous families settled there (Instituto Amazónico de Investigaciones Científicas—SINCHI 2017). For these reasons, the communities of the sector of the middle Caquetá river, on 23 August 1988, formed what is currently known as Association Council of the Regional Indigenous of the Middle Amazon-CRIMA with the aim of generate development from the perspective of indigenous cultures; this association is composed of 16 communities of four indigenous ethnic groups (uitoto, muinane, andoque and nonuya), under a structure that includes a Congress, a Board of Directors, an Executive Committee and five areas of coordination: Health, Own Territory-Government, Education, Women and Natural resources" (Instituto Amazónico de Investigaciones Científicas—SINCHI 2017).

The role of indigenous people is therefore locally crucial for the preservation of high levels of agrobiodiversity. Results, in fact, highlight that the Reserve of Monochoa is characterized by high levels of agrobiodiversity related to the maintainance of traditional agroforestry practices, especially of the system called *chagra*.

Some authors criticized these traditional practices, especially in the '90s, as the removal of forests to obtain agricultural products was mainly perceived as a threat to biodiversity (Myers 1992; Lawrence et al. 2010). In reality, thanks to their recognition at legislative level and their activities, indigenous populations can effectively act as a defence against deforestation (Angelsen 1995). Large scale deforestation is in fact the main threat for the Amazon rainforests and its biodiversity, causing different problems not only in the region where it is carried out, but also to all neighbouring countries. In particular, its negative effects affect the so-called triple A corridor (Andes–Amazon–Atlantic all connected in one system), that is vital since almost the entire continent depends on the 200 billion tons of water that travel from the Atlantic Ocean and are

absorbed by the flora of the Amazon. Thanks to the heat, 600 million trees transpire through roots and leaves, creating the steam that the wind pushes towards the Andes so that water becomes again liquid and irrigates the earth, until returning to the sea (Calle 2017). Large scale deforestation can cause a multiplicity of problems, especially in relation to the alteration of the water cycle and the alteration of the soil capacity to capture and absorb rainwater as well as the consequent erosion and changes in water supplies and characteristics that is fundamental for the water used in the bigger cities of the area where the majority of people live (Corte Suprema de Justicia 2018). Despite environmental problems, large-scale deforestation deeply affects social and cultural capital (van Vliet et al. 2012, 2013), in which indigenous peoples have been particularly affected because of their close relationship with their local environment (Fonseca-Cepeda et al. 2019).

In terms of ecosystem services, La Rotta (1982) affirms that the rotation of land and the recovery time that allows to restore the previous vegetation after a period of 10–15 years, is the result of detailed knowledge about soil characteristics and adequate use of the recycling of the vegetal layer. In that sense, Henao (1990) complements the previous ideas by noting that maintaining a quantity of energy usable by man, forces the replacement in the same amount to the system, making it possible to keep the ecosystem balance. This energy management is manifested in the replacing of the plant elements through genetics, ensuring to the forest that its original genetic characteristics are maintained. Traditional agroforestry practices ensure the perpetuation of the species, together with all the other components of the ecosystem, such as associated fauna, soil fertility regeneration and water cycle regulation (Instituto Amazónico de Investigaciones Científicas—SINCHI 2011). Thus, the legacy of the indigenous communities consists in raising social awareness about the role of the environment to maintain life, which only is possible through the respect of mother nature. Following this cosmovision, indigenous communities have developed their life around *chagras*. *Chagras* are at the basis of their society organization and cultural diversity. In this sense, they are the tangible representation of their culture and the foundation of the internal social organization: all the families of the community are organized around the *chagras* system and the roles of each one of its members is established according to it. However, this organization also includes other components of the ecosystem: plants, animals and divine entities. Through *chagras*, indigenous communities reproduce physical and intangible elements of their cosmology in a geographically and temporally defined space through interactions within the social-ecological system (Carrizosa 2016). Cultivated species are crucial in both ensuring high quality food to the local indigenous population and in preserving Amazonian agrobiodiversity through in-situ genetic banks (Gainza 2008).

Protecting *chagras* and traditional shifting agriculture all over the world is of vital importance also to ensure adequate nutrition of the communities and the preservation of their traditional knowledge. Indigenous families are becoming less self-sufficient and more dependent on the market, at the expense of their quality of life. This trend, however, is common not only in Amazon, but also in some Asian countries: when indigenous people sow, hunt, fish and collect by themselves, they obtain food and resources of excellent quality, when they cannot do it, they buy generally low quality food from the markets which affects their health (Umbarila 2018; van Vliet et al. 2012; Cramb et al. 2009; Schmidt-Vogt et al. 2009). On the other side, it is important to remember that the abandonment of traditional practices can also be due to the demand of accessing formal education and better health care system, but the case of Monochoa highlights that it is possible to have multiple benefits for the entire local societies that have organized themselves at an institutional level to carry out their demands.

Conclusions

Chagras and their traditional practices based on itinerant polyculture, allow the indigenous community of Monochoa to manage all the resources present in the Amazon in the most sustainable way possible. This includes obtaining resources for their families without the use of additional chemical fertilizers or pesticides, only relying on their traditional knowledge which represents the key factor for the Amazonian conservation, in order to give the same opportunities that they had, to the future generations. The research confirmed that environmental impact of this agricultural system is minimum (Triana-Moreno et al. 2016), and therefore the *Chagras* systems should be integrated in territorial planning and conservation initiatives for a more sustainable future of the Amazon (Fonseca-Cepeda et al. 2019). Moreover, the research highlighted that indigenous traditional knowledge developed through the centuries, based on the respect and equilibrium with the surrounding environment is the key for the sustainable development and for the wellbeing of local communities as well as for the preservation of biodiversity and ecosystem services. Agroforestry systems based on traditional forest-related knowledge all over the world (Santoro et al. 2020) can therefore represent an effective alternative to biodiversity and ecosystem services conservation based on strict nature protection where humans are perceived as a negative factor.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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