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Darío Pérez, Lauren Raz

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Darío Pérez[1,2,3], and Lauren Raz[1]

[1] Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia
[2] PHIM Plant Health Institute, Institut Agro, Université de Montpellier, IRD, CIRAD, INRAE, Montpellier, France
[3] PALOC, IRD, Muséum National d'Histoire Naturelle, Paris, France
*Corresponding author; e-mail: lraz@unal.edu.co

Tracing the Supply Chain of Medicinal Wild Yam Species (*Dioscorea* spp.) in Cundinamarca, Colombia. Wild yams (*Dioscorea* spp.) are widely distributed non-timber forest products that are traditionally used as medicine in Cundinamarca, Colombia, and represent a source of income for rural families in the region. The market for these native medicinal species has been growing due to their increasing popularity as a remedy for circulatory and blood problems; however, the supply and demand dynamics of this plant in the forest have not yet been documented. Through qualitative research methods, this study identifies the links and distribution of the wild yam supply chain in Cundinamarca and considers the implications for conservation and sustainability of the resource. Tuber collection was documented in forested areas in 14 municipalities in the Department of Cundinamarca. The tubers are destined for wholesale markets in Bogotá and are purchased by retailers from all over Cundinamarca, even those based in the municipalities from which the tubers were extracted. The collection, distribution, and consumption of *Dioscorea* species in Cundinamarca respond to growing demand and rely on extraction of the species directly from forest remnants within the Department; these could be at risk of overharvesting if management measures are not taken, or if participatory propagation programs that benefit harvesters and sellers are not implemented. This is the first study of the supply chain in an emerging new market for wild yams in Latin America. It highlights the dynamic, evolving nature of the medicinal plant trade from the local to the national scale, and beyond.

Key Words: Colombian medicinal flora, folk medicine, non-timber forest products, overharvesting, supply chain

Los ñames silvestres (*Dioscorea* spp.) son productos forestales no maderables de amplia distribución y uso tradicional como medicina en Cundinamarca, Colombia. Su comercialización genera ingresos para familias campesinas en la región. El mercado para estas especies medicinales nativas ha venido creciendo debido a su popularidad como remedio para problemas sanguíneos y circulatorios, sin embargo, las dinámicas del suministro y demanda de esta planta en el bosque aún no han sido documentadas. A través de métodos de investigación cualitativa, este trabajo identifica los eslabones y distribución

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de la cadena de suministro del ñame silvestre en Cundinamarca y considera las implicaciones para la conservación y sostenibilidad del recurso. La recolección de tubérculos fue documentada en zonas boscosas de 14 municipios en Cundinamarca. Los tubérculos son destinados para la venta en mercados de Bogotá donde son comprados por mayoristas quienes los revenden a comerciantes a pequeña escala de toda Cundinamarca, incluyendo aquellos que están radicados en los mismos municipios donde se extrae el recurso. La recolección, distribución y consumo de especies de Dioscorea en Cundinamarca responden a una creciente demanda de un producto que es extraído de los remanentes de los bosques en el departamento; las poblaciones de ñame silvestre pueden estar en riesgo de sobreexplotación si no se implementan medidas para su manejo o programas de propagación participativos que beneficien a quienes recolectan y comercializan esta planta. Se presenta el primer estudio sobre la cadena de suministro en un mercado emergente para ñames silvestres en América Latina y resalta la naturaleza dinámica del comercio de plantas medicinales a nivel local, nacional y más allá.

Introduction

The harvest and consumption of plant products derived from tropical forests are ecosystem services that meet the basic needs of the communities that depend on them for their livelihoods (Padoch 1992). About 80% of the population of the developing world uses wild plants and, especially, non-timber forest products (NTFP) for subsistence and trade (Chavan et al. 2016; Dovie 2003), constituting an alternative source of income for thousands of families worldwide (Angelsen et al. 2014; Arnold and Ruiz 2001; Shackleton et al. 2007).

However, when demand for these plant products increases and there is no management strategy in place (Casas et al. 2007), the extractive pressure exerted on local ecosystems can lead to overharvesting (Bernal et al. 2011; Ticktin 2004). The design and implementation of appropriate strategies to reduce the ecological impacts of harvesting should help convert NTFPs into a sustainable alternative to generate income at the regional level (Gaoue et al. 2016; Hernández-Barrios et al. 2015).

On the other hand, the value of NTFPs should not be measured only in their potential to create profitable businesses. Extraction of these products is often a part of traditional ecological knowledge systems and biodiversity conservation at local and regional scales is put at risk when this knowledge is lost. Non-timber forest products may be replaced or forgotten by the local communities that no longer harvest and/or propagate them, leaving fewer incentives to conserve forest habitat (Medeiros et al. 2021; Reyes-García et al. 2007).

Although there are market opportunities for some NTFPs in Colombia, community participation in their commercialization remains limited (López 2008). The few state incentives that exist for biotrade and the scarcity of basic research in this area promote the establishment of production systems that favor the market model instead of traditional knowledge about biodiversity and local economies (Maraseni et al. 2006; Silva et al. 2017; Varghese and Ticktin 2008). An example of a non-timber forest product that is increasing in popularity is wild yam (*Dioscorea* spp.), a genus of medicinal plants with diverse biological activities linked to the secondary metabolites found in its rhizomes and tubers, mainly allantoins and steroidal saponins (Chandrasekara and Kumar 2016; Ramos-Duarte et al. 2015).

In Mexico, species of the genus *Dioscorea* from native forests constituted the raw material for the global production of synthetic steroid hormones from the 1940s to the mid-1970s (Hinke 2008). In 1951, chemists Luis Miramontes, Carl Djerassi, and Jorge Rosenkranz developed a process using the precursor diosgenin, extracted from wild yam tubers, to synthesize norethisterone, one of the active ingredients in oral contraceptives, considered one of the most important inventions in the history of humanity (Le Couteur and Burreson 2003). Mexico was the most important supplier of steroids in the world during the mid-20th century (Marks 2001) and collection of wild yams became the main source of income for entire communities until the 1970s (Soto-Laveaga 2005). By this time, serious extractive pressure was already mounting on native yam species, but it was a change in the political winds that drove the industry into a death spiral. Popular pressure from student movements

and organized labor in Mexico led to the nationalization of the yam trade, driving pharmaceutical companies worldwide to look for other sources of progesterone precursors. Later in the decade, the total chemical synthesis of oral contraceptives was achieved, making wild yams expendable in the process. The market for Mexican *Dioscorea* spp. was basically extinguished by the late 1980s, leaving nearly 10,000 families without a livelihood (Soto-Laveaga 2009). As we consider the role that wild yams and other NTFPs can play in a future bioeconomy in Colombia and elsewhere, it will be important to learn from Mexico's experience in order to protect communities from both ecological and economic disaster.

Today a great diversity of medicinal plants is sold throughout Bogotá (Bussmann et al. 2018) and, in particular, there is a growing market for wild *Dioscorea* species (Pinzón-Rico and Raz 2017). In order to develop actionable strategies for the sustainable management of Colombian wild yams, many information gaps still need to be filled, especially about the supply chain and, in particular, the communities that participate in extraction of the resource. To date, supply chains have been studied for very few wild plants in Colombia (Andrade-Erazo et al. 2020; García et al. 2015; Isaza et al. 2014; Vallejo et al. 2016), and there is a lack of studies about wild medicinal plants of Colombia (Vásquez-Londoño and Bernal 2011).

Here we present an investigation of the supply chain of wild *Dioscorea* species in the Department of Cundinamarca, where Bogotá is located. We asked the following questions: In which municipalities of Cundinamarca are tubers extracted directly from the field? How do local markets fit into the supply chain? How is the market organized at the department level? Understanding the supply chain for this NTFP in Colombia is key for the formulation of management plans that favor the socioeconomic development of collectors and their communities, the valuation of their traditional ecological knowledge, and the sustainable use of the species.

Materials and Methods

Although wild yam is distributed in several regions, we decided to limit the sampling to the marketplaces of Cundinamarca because previous studies indicate that there is a growing market in Bogotá (the capital city of Colombia). The Samper Mendoza District Market Square is the largest market of medicinal plants in the country. The tubers come from several municipalities of the Department of Cundinamarca (Pinzón-Rico and Raz 2017). Located in the center of Colombia, surrounding Bogotá, the diversity of climates and local landscapes makes the Department of Cundinamarca the main region that distributes and supplies basic necessities to Bogotá, which is especially relevant considering that Bogotá is the most populated city in Colombia. This Department is administratively subdivided into 116 municipalities and, in each of these, there is a central marketplace with at least one medicinal plant marketing point (MPMP). The presence and distribution of *Dioscorea* species in rural areas of the Department of Cundinamarca was obtained from the records of botanical specimens available for this genus in the Colombian National Herbarium (COL) (Raz 2015). With this information, the sites in Cundinamarca that have ideal conditions for growing wild yams were identified and initial visits were made to MPMPs in nearby towns. From this information, a theoretical sampling was carried out (Flick 2014). The size of the sample was defined according to the information provided by each of the links in the route of wild yam harvest and marketing, applying a "snowball" technique (Albuquerque et al. 2014), in which the sellers who were initially interviewed suggest other people who can provide more information about the product supply chain in Cundinamarca.

Of the 116 municipalities in Cundinamarca, we visited 69 central markets (59%), one per municipality. Following the "snowball," we visited 11 of the 19 public marketplaces in the city of Bogotá (58%), where they reported the distribution of wild yam (Electronic Supplementary Material—ESM). In that sense, we conducted 80 interviews, one in each MPMP visited.

Once the presence of the plant was identified in the MPMPs, a qualitative interview was conducted with each seller (Bonilla-Castro and Rodríguez-Sehk 1997), with questions about the identification, harvest, commercialization, and uses described by consumers. As a result of the information provided about harvesting by sellers, 14 semi-structured interviews were conducted with farmers who supply tubers to local

markets. These 14 farmers were in charge of supplying tubers in the markets visited in Cundinamarca and sold both for their own MPMPs and for other localities. After each interview, an expedition was carried out to the wooded area from which the tubers were collected and where the collector developed his/her strategy for harvesting wild yam. This information was registered through participant observation (Almeida-Campos et al. 2019). In addition, semi-structured interviews were conducted with the collectors, recording their knowledge about uses, transportation, marketing, and consumption of wild yams in the region. Moreover, among the municipalities visited, the presence of wild yam was recorded in 44 places close to the population centers of each municipality and in the rural areas of Bogotá (Fig. 1, ESM). The information from each interview was consolidated in a matrix in Microsoft Excel®, and was systematized to obtain the percentages of absence/presence of wild yam in each MPMP visited, the species found, the common names, the uses popularly attributed in trade, the origin and distribution of the tubers, and general observations of their sale. Thematic mapping of the wild yam supply chain was carried out using QGIS® software.

Results and Discussion

Harvesting Wild Yam from the Forest

We identified 14 people who harvested wild yams directly from forested areas in the Department of Cundinamarca. These collectors are traditionally engaged in agriculture and cattle raising. The collection of wild yam and other NTFPs is complementary to their main economic activity as sellers and distributors of medicinal plants in their MPMPs. Each collector identified the places where he/she could obtain wild yams based on information that came from their colleagues, as well as from their own personal experiences. Many of the collectors mentioned that in recent years the availability of the plant in the environment has decreased. In previous years it was easier to find tubers on the edges of the main roads that connected municipalities, but now it is necessary to go deep into the woods.

This availability is also reflected in the variety of yams. All the collectors consulted indicated that although customers prefer a variety call "zarzaparrilla roja" (red zarzaparrilla, in English, *Dioscorea coriacea* Humb. & Bonpl. ex Willd.), it is becoming increasingly scarce. As such, they are forced to extract other varieties, especially the variety called "zarzaparrilla blanca" (white zarzaparrilla), also *D. coriacea*, a species that displays a complex variation (Raz 2015), since these varieties are easily found in the field. The decrease reported by collectors is a first record of the change in abundance and variability of wild yam in the field, and suggests that commercial demand has promoted harvest intensity, as happens with NTFPs when they become an alternative option for the subsistence of harvesting families (Belcher et al. 2005; Ros-Tonen and Wiersum 2003).

Collection of wild yams is generally done individually and on a weekly basis. Nobody harvests tubers of relatively small sizes because they are not attractive to customers at the MPMPs and, therefore, they are not sold. For each farmer, the harvest of the day generally coincides with the maximum weight they can carry back home. The collectors interviewed extracted yams directly from the local forest, preferring tubers with an approximate weight of 25 kg; however, they do not always find the ideal size and are forced to carry several tubers, adding up to the preferred weight.

The collectors interviewed are also the owners of their respective MPMPs in local markets. The sale of wild yams is not their main source of income as they also sell other medicinal plants. Only one collector supplies the main supply center of the city of Bogotá, the Samper Mendoza District Market Square; he collects 20 to 30 tubers per week, which he obtains from the rural area of the municipality of La Mesa.

After harvesting, tubers are transported to the MPMPs where they are displayed for sale. Only 21% of the informants mentioned transporting the tubers extracted from the native environment directly to marketplaces located in larger cities, specifically Facatativá, Girardot, and Bogotá. However, these collectors supply the demand of the big cities by transporting a higher quantity of tubers, compared to the collectors who sell them in their own stalls.

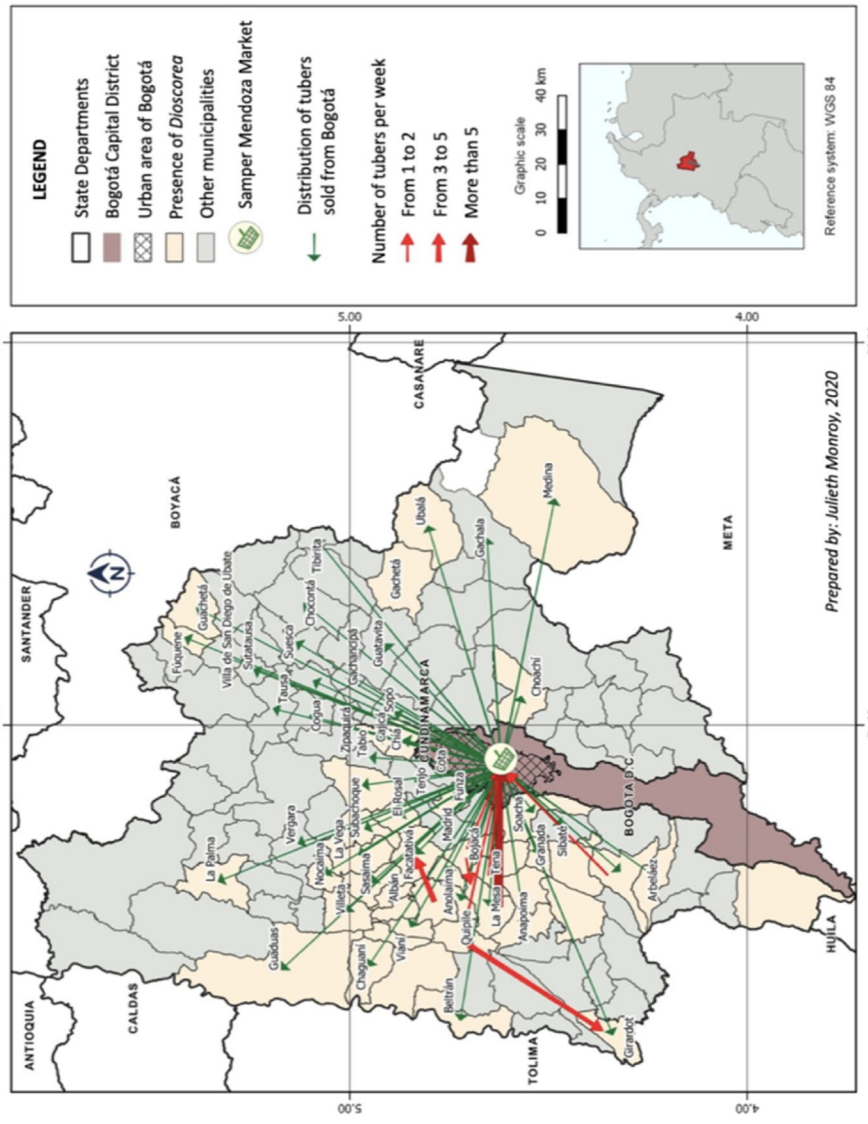

Fig. 1. Presence of wild yams (based on herbarium samples and field work): Origin of the traded tubers, and destination of the tubers after arriving at the large supply centers in Bogotá (see ESM for detailed information on the municipalities visited).

From the municipality of La Mesa, the largest number of wild yams is transported to the city of Bogotá, specifically to the Samper Mendoza District Market Square. The higher extraction rate in this municipality can be explained by the presence of one collector who transported the largest quantity of tubers to Bogotá—not necessarily by the abundance of wild yams in the field. Thus, for him this dynamic is economically profitable, and for this reason he continues to carry out his weekly collection. If the market continues to grow, it likely would be necessary to find new players who can carry out a massive extraction. Other factors that determine the success of his business is the relatively easy access to the harvest areas and the proximity of his collection site to Bogotá. This proximity makes it easier for tubers to be distributed and sold to the different supply centers and mobile stands in Bogotá, and to 59 of the 69 municipalities visited in the Department of Cundinamarca, including La Mesa (Fig. 1).

Sale of Wild Yam in Cundinamarca

At the MPMPs that were visited, 80 people between the ages of 28 and 59 were interviewed. Of those, 66% were women and the remaining percentage were men, which suggests that the sale of medicinal plants is a task that, for reasons of custom and credibility, is done mostly by women. The men who are in charge of selling medicinal plants resort to developing a more elaborate argumentative discourse to persuade customers to purchase their products since, according to the sellers themselves, the women are the ones who traditionally know and use the plants medicinally to take care of the family (Mosquera-Mena et al. 2015; Nascimento et al. 2013; Toscano 2006). However, the percentages are not sufficient to affirm that this is a trend. Despite the perception of the sellers and data from other regions of the country, in the Cundinamarca and Bogotá marketplaces, we observed that both men and women are representative figures of popular medicine and are sought out to alleviate health problems, regardless of gender, before consulting the conventional medical system (Jaramillo et al. 2007).

All of the sellers visited indicated that they recognize wild yam species as medicinal plants, with the common name *zarzaparrilla*; among these, 86% sold the plant at their MPMP. Sellers identify *Dioscorea* tubers with the name *zarzaparrilla*, and roots with the same common name but of the *Smilax* genus (Bussmann et al. 2018; Pabón et al. 2017), coinciding with the report by Pinzón-Rico and Raz (2017). According to the responses, the sellers clearly distinguish the morphology and uses of each one, commonly differentiating them as *zarzaparrilla de raíz* (root zarzaparrilla) in the case of *Smilax* spp., and *zarzaparrilla de pepa* and *cepa de zarzaparrilla* (seed zarzaparrilla and zarzaparrilla stem) in the case of *Dioscorea* spp.

Three native species of wild yam are traded in the marketplaces visited (Fig. 2): *Dioscorea coriacea* Willd., *Dioscorea polygonoides* Willd., and *Dioscorea lehmannii* Uline. These species are characterized by the color of their parenchyma, their external appearance, and their taste (Raz 2015). These species also correspond to those reported as sold in the Bogotá marketplaces (Pinzón-Rico and Raz 2017).

In the MPMPs, three common names are distinguished with diagnostic characteristics that do not necessarily determine different species: "zarzaparrilla roja," "zarzaparrilla blanca," and "zarzaparrilla víbora" (red zarzaparrilla, white zarzaparrilla, and viper zarzaparrilla, respectively). Red zarzaparrilla gets its name from the reddish color of the parenchyma, either innate or acquired after an oxidation process from strong yellow to red. It is also called the "zarzaparrilla dulce" (sweet zarzaparrilla) for its insipid flavor, regardless of the preparation, and it is the most desired by users since it is not only more palatable but, when consumed, it is perceived to have greater healing effectiveness. White zarzaparrilla has a creamy-white color in its parenchyma and is also called the "zarzaparrilla amarga" (bitter zarzaparrilla) since its flavor is very strong when it is drunk in infusion at high temperatures, so it is advisable to take the infusion at room temperature. Viper zarzaparrilla, which is generally associated with *D. polygonoides*, gets its name from its structure "similar to a viper's skin." Its taste is bitter and it is sold in smaller quantities because it is not as popular as the others. This report for Cundinamarca, which confirms the expansion of the market due to the popularization of the uses of wild yam in the region, coincides with that mentioned by Pinzón-Rico and Raz (2017) for Bogotá marketplaces.

Regardless of the common name, all vendors promote the use of wild yam to improve the

Fig. 2. *Dioscorea* species sold in Cundinamarca. (**a**) *D. polygonoides* Humb. & Bonpl. ex Willd., (**b**) *D. lehmannii* Uline and (**c**) *D. coriacea* Humb. & Bonpl. ex Willd.

health of patients with problems related to blood circulation and to "clean the blood." According to the vendors, it is effective in treating problems caused by high concentrations of sugar, triglycerides, and/or cholesterol in the blood. This popular use is consistent with several studies that report the action of wild yam species in cholesterol, obesity, and diabetes problems (Liu et al. 2015; McKoy et al. 2014, 2015; Omoruyi 2008; Pan et al. 2013; Wang et al. 2012).

Since consumers do not select wild yams based on external characteristics and look for tubers to remedy the same health problems, the supply in MPMPs depends on the availability in the forest. The extraction rate is determined by the increase or decrease in demand. With 65% of the MPMPs surveyed offering this product, *D. coriacea* is the most frequently sold wild yam species, followed by *D. polygonoides* with 32%, and *D. lehmannii* with 3%. Although neither the reproductive rates of the species nor their abundances are known, it is probable that these percentages can be explained by the local availability of the species in the forests (personal observation).

Wild Yam Market in Cundinamarca

As reported by Pinzón-Rico and Raz (2017), sellers of medicinal plants in the marketplaces in Bogotá and Cundinamarca say that wild yam is one of the products with the highest turnover in the market and that its popularity has increased in recent years.

In the wild yam trade, the market is informal. There is no regularization of the prices of tubers in the MPMPs, nor standardization of units of measurement or prices with respect to quantities sold. Likewise, prices are subjective due to the strategies of each seller and the location in the supply chain, meaning that physically identical tubers can be sold at different prices. This subjective price management causes precariousness in the income of retail sellers and collectors (Hersch-Martínez 1995) and, consequently, suggests that regulation of this growing market in farmers associations would ensure a fair price and harvest according to the natural regeneration of the plant. The lack of regulation of the market for *Dioscorea* species can be due to the unawareness of the supply chain and the volumes that are traded, a problem in common with most medicinal plants sold in marketplaces in Colombia (Díaz 2003).

The unit of measure for sale is a slice of approximately 100 g, with an average price of 1,000 COP (approx. USD 0.30), although it is also possible to sell half or the whole tuber and its price varies depending on the size, on average, from 20,000 COP (approx. USD 5.60) for

a tuber of approximately 5 kg and up to 40,000 COP (approx. USD 1.20) for a tuber of approximately 15 kg.

Considering the prices at each MPMP, a supply chain for the sale of wild yam is configured in Cundinamarca (Fig. 3), beginning with the harvest that, although it implies an investment in effort, generally does not imply any monetary investment from farmers. Subsequently, the sale of tubers is carried out through two strategies: Sale by collectors themselves and sale to third parties. When sold by collectors, each tuber is marketed in slices or flakes, directly at the MPMP; when sold to third parties, the tuber is transported to be sold in wholesale supply centers, especially the Samper Mendoza District Market Square.

The sale to third parties represents greater profits when the collection is distributed to wholesale supply centers since the quantity of tubers that are sold per month increases; however, collection has to be carried out more frequently and it is necessary to invest money in transportation. To maximize this investment, usually other medicinal plants are transported in the same shipments.

Wild yam sellers in wholesale supply centers interact directly with the collectors and sell the tubers transported by them in relatively low volumes, generally negotiating the prices together with other medicinal plants. However, the growing demand by customers has made this an indispensable product of the MPMPs.

The sale of wild yam in low volumes is the most profitable business because they can get the best prices for each tuber, while the sale price is significantly reduced when it is sold in large quantities, as when sold to naturopathic laboratories. This study does not present specific data about the commercialization in naturopathic laboratories since the sellers do not give precise data about the production volumes with *Dioscorea* species. There are drugs on the market that claim to have *zarzaparrilla*, but it is not certain if they refer to a *Smilax* species or to wild yam. This is a study that should be done, especially considering that Colombian legislation still does not allow the synthesis of drugs from *Dioscorea* spp.

Although native *Dioscorea* spp. are known to occur in forests throughout Cundinamarca (as documented by herbarium specimens), commercial harvesting is practiced in very few municipalities. In 80% of the municipalities in which *Dioscorea* species are reported as native, according to herbarium records and observations in the field, tubers are obtained from wholesale supply centers rather than local collectors. The main wholesale supplier of wild yam is the Samper Mendoza Market Square in Bogotá, which obtains the tubers from the municipality of La Mesa and distributes them throughout Cundinamarca and Bogotá (Fig. 1). Only 19% of the MPMPs visited sell tubers that are extracted from the same municipality; all the rest buy tubers from wholesale supply centers located in Bogotá, including La Mesa municipality's marketplace. Thus, despite Cundinamarca being the primary source of wild yams, most tubers sold in local markets within the Department come from Bogotá (Fig. 1). This explains the importance of Bogotá for the commercialization of wild yams and, to that extent, the popularization of traditional knowledge that, although it comes from rural areas, uses urban areas for its propagation.

Wild yam species are broadly distributed in Colombia, but they are most commonly found in Andean cloud forests on steep slopes with well-drained clay soils. Moreover, these characteristics suggest possibilities for expanding harvesting in optimal areas for the natural regeneration of tubers, like the Andean forests found in the Tequendama region.

Although some of these areas have national or regional protected status, medicinal plant collectors harvest from them periodically. Our data document for the first time the supply of the wild yams traded in marketplaces and show an initial picture of scarcity perceived by the farmers interviewed, but the data are insufficient to affirm the decline of the wild yam population. However, collecting activity is generally limited to places that are not far from the road or residences, which could suggest the population decline of this plant in these specific sectors due to the pressure generated by highly localized overharvesting, a phenomenon that has been reported for some palm species in South America (Mesa-Castellanos et al. 2017; Virapongse et al. 2017), and would explain the scarcity perceived by the farmers consulted.

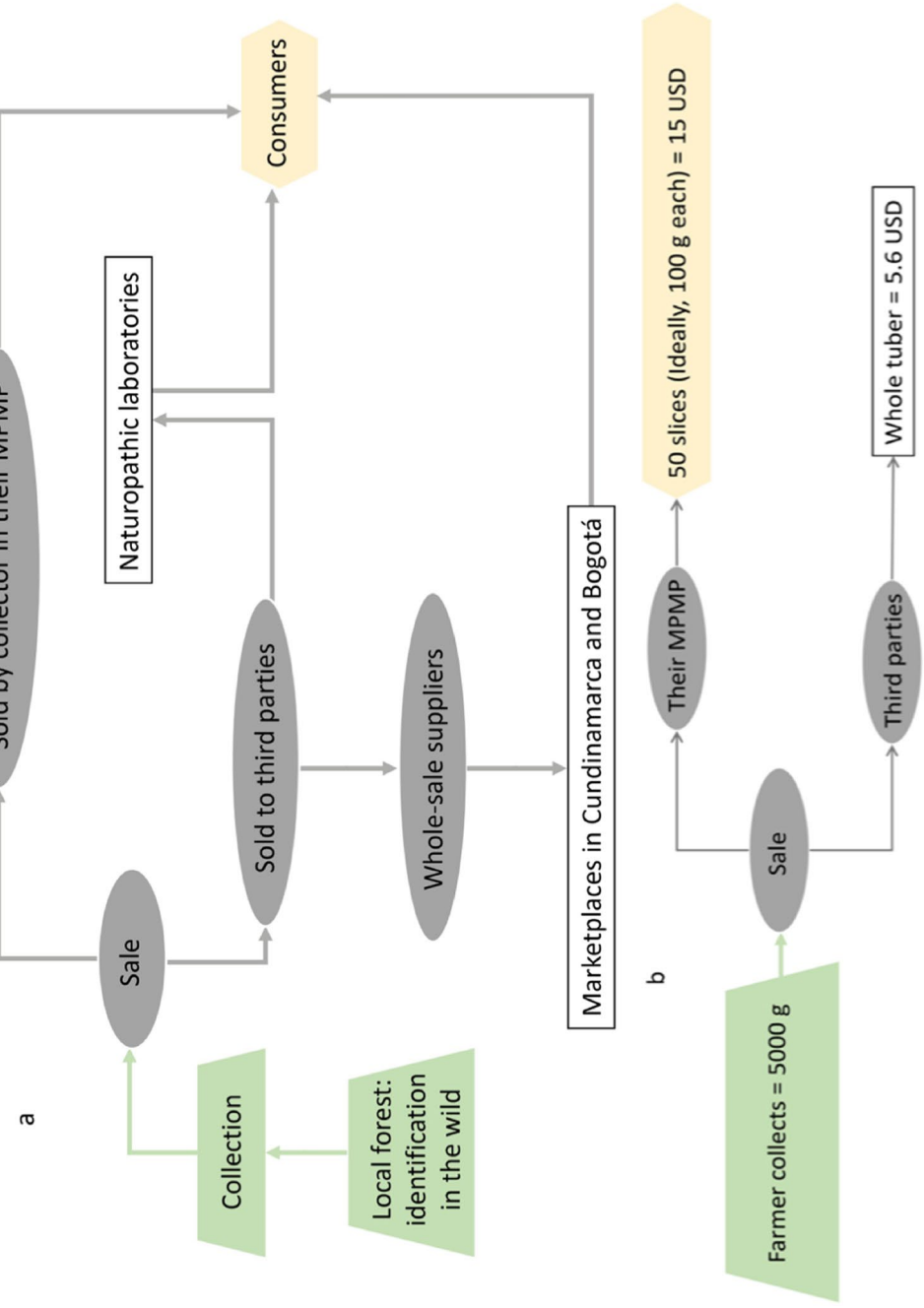

Fig. 3. (**a**) Wild yam supply chain and (**b**) price variation through the supply chain.

In the case of wild yams, accessibility to harvesting areas is a key factor to meeting the local demand, considering the difficulties of extracting and transporting whole tubers. Accordingly, in the municipalities where harvesting of *Dioscorea* spp. occurs, the tubers are collected from forests in rural areas, and are sold in the closest local markets, as expected. However, in many municipalities where collecting activity was expected based on the known distribution of native *Dioscorea* spp., there was no local harvesting and the nearby markets were instead supplied from wholesale markets in Bogotá. We found that wild yam was present in 44 municipalities visited (including the 23 municipalities registered in the Colombian National Herbarium) and in rural areas of Bogotá. This finding indicates that harvesting is practiced over a more limited geographic area than expected and suggests that knowledge of this practice is similarly restricted. Wholesale markets in Bogotá, with their larger volumes and commercial dynamics, are supplied, as expected, from nearby municipalities that have ideal growing conditions for wild *Dioscorea* spp. (Pinzón-Rico and Raz 2017).

In South America, supply chains for wild plants have been widely reported for palm species (Andrade-Erazo et al. 2020; Bernal et al. 2010, 2011; Brokamp et al. 2011; García et al. 2015; Lescure et al. 1992; Padoch 1992; Virapongse et al. 2014). However, in-depth studies are lacking for most medicinal wild plants. This is the first study of a supply chain for medicinal wild yam species in Colombia or elsewhere in South America. While our study area was confined to Cundinamarca, a smaller market for *Dioscorea* spp. also exists in Medellín, Colombia's second largest city (personal observation), and we expect that Andean wild yams could have prospects for broader commercialization in national and international markets (Pinzón-Rico and Raz 2017).

Conclusions

Wild yams are native medicinal plants, the market for which has been growing due to their popularity as a remedy for circulatory and blood problems, and with economic potential for medicinal plant traders in the Department of Cundinamarca. The supply chain of wild yams suggests that the forested areas of the Department are the primary source of this NTFP, but that harvest activity is highly localized, and extraction pressure is therefore concentrated in specific plant populations. This study also broadens the geographic area in which medicinal uses of these species have been documented, beyond the purely urban context of earlier research (Pinzón-Rico and Raz 2017). By identifying current and potential source areas of wild yams, this study provides key data for developing conservation initiatives and plans for sustainable resource management. Identification of the actors in the supply chain is also a key step to ensure that rural community members and their knowledge be taken into account in the development of such plans.

Due to the popularization of their uses, the increase in demand for Andean wild yams in the marketplaces of Cundinamarca and Bogotá presses not only the need for documenting the regeneration rates and natural growth of the plant, but also for the formulation of management plans for the species, to avoid the decline of this plant in local forests and to promote this non-timber forest product as an alternative source of income for farmers in the region. Hence, it is necessary to generate management policies for this NTFP that are consistent with the regional context, supporting fair market options for those who are part of this supply chain.

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Declarations

Ethics Approval Permission to conduct interviews in the marketplaces of Bogotá was obtained from the Institute for Social Economy (IPES). We conducted a prior consultation with the vendors and collectors of Cundinamarca and Bogotá in which we explained the objectives and methodology of the research, and requested permission to interview them at their workplaces and visit their collection sites. The people interviewed for this study own and have the rights to their popular knowledge about medicinal plants and, specifically, wild yams. Any commercial use of this information must be subject to international and national legislation on medicinal plants and traditional knowledge associated with biodiversity, and requires prior consent from the informants involved and an agreement on the distribution of benefits.

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