Ethnobotanical inventory of Peruvian plants used in folk medicine in the province of Purus, Peru

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Ethnobotanical inventory of Peruvian plants used in folk medicine in the Province of Purus, Peru

Doctoral Thesis

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Prague, February 2024

Declaration of Authorship

I hereby declare that the "Ethnobotanical inventory of Peruvian plants used in folk medicine in the Province of Purus, Peru" thesis, submitted as a partial requirement for the Ph.D. degree at the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, is solely my own work, except where explicitly cited in the reference section. Furthermore, I confirm that this work has not been submitted for any other degree at this university or any other institution.

Prague, 2023

....

Jana Horáčková

“The Indigenous approach is oriented towards fostering an active relation between humans and non-humans, based on an understanding that all things classified by the western taxonomy as plants, animals, mountains, among others, are beings with their own vitalities and souls.”

Viveiros de Castro

“So many and so many existences you hear, so much silent wisdom you hear when you listen to the jungle.”

Cesar Calvo

“Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.”

Albert Einstein

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List of abbreviations

AISPED	The Brigade for Integrated Health Care for Excluded and Dispersed Populations
AMETRA	Proyecto Aplicación de Medicina Tradicional – Traditional Medicine Application Project
APG IV	The Angiosperm Phylogeny Group IV system of flowering plant classification
CBD	Convention on Biological Diversity CBD
CL	Cutaneous leishmaniasis
FECONAPU	Federación de las Comunidades Nativas de Purús (Federation of Indigenous Communities of Purus)
HK	Hantxa Kuin language
IIAP	Instituto De Investigaciones De La Amazonia Peruana (Peruvian Amazon Research Institute)
ICIPE	International Centre of Insect Physiology and Ecology
ICT	Indigenous community territories
IPLCs	Indigenous peoples and local communities
IUCN	Red List of Threatened Species
IVITA	Instituto Veterinario de Investigaciones Tropicales y de Altura (Veterinary Institute for Tropical and High Altitude Research)
LBO-2	Local Biodiversity Outlooks 2
NMEs	new molecular entities
NTD	Neglected Tropical Diseases
TK	Traditional knowledge
PPG I	The Pteridophyte Phylogeny Group I system of pteridophytes (lycophytes and ferns) classification
S	Spanish language

SICNA	Sistema de información sobre las Comunidades Nativas del Perú (Information System on Peruvian Native Communities)
UGEL	Unidad de Gestión Educativa Local (Local Education Management Unit)
UNIA	Universidad Nacional Intercultural de la Amazonía (National Intercultural University of the Amazon)
UR	Use Report
WoS	Web of Science

Abstract

Indigenous peoples and their traditional knowledge are essential in global efforts to preserve nature, evaluate scientific methods and achieve the Sustainable Development Goals outlined in the UN Agenda 2030 strategy. The overall goal of the present doctoral study was to document the traditional medicinal plant use in Cashinahua rural communities through an inventory of the plant species used for medicine in the study area; the recording of ethnobotanical knowledge, including modes of preparation and administration; documentation of the traditional system of Cashinahua phytomedicine; and identification of potential neglected medicinal plant species and ethnopharmacological applications.

Field research spanned 11 months between November 2010 and June 2015, covering various seasons, in Cashinahua communities on the upper reaches of the Curanja River. Prior to any research activity, informed consent was obtained from village chiefs. Data were collected through a combination of participant observation and semi-structured interviews with 20 respondents (10 men and 10 women) deemed specialists in their community's knowledge of medicinal plants. Seventy-five percent of the respondents were aged between 60 and 80 years. Furthermore, in four of the five studied communities, semi-structured household interviews were conducted with 68 community members (35 men and 33 women) with an average age of 41.2 years. This second dataset aimed to record the practical knowledge of local medicinal plant use from the perspective of community members. In addition, it incorporated demographic data, health essentials, attitudes, perceptions, and usage trends.

All relevant ethnobotanical studies conducted in the Peruvian Amazon and neighbouring regions of Brazil and Bolivia were compared to the medicinal plant species present in the study area. Then quantitative ethnobotanical indices to analyse the traditional knowledge of the informants and determine the cultural significance of certain medicinal plants were calculated. To compare the diversity of species used by different ethnic groups, Jaccard's similarity indices were calculated. An analysis of medicinal plant overlap was conducted, followed by calculation of the informant consensus factor, to examine the consistency of ethnomedical knowledge. Additionally, a review of literature indexed in the Web of Science from 2018 to 2022 was performed to cross-reference ethnopharmacological, pharmacological, and phytochemical applications. On the basis of this criterion, a selection of 79 species that had not been previously recorded or had only been infrequently reported for medicinal or pharmacological purposes were identified.

Four hundred sixty-seven medicinal plants were documented, belonging to 253 genera and 99 botanical families. Of the taxa identified to species level, 83.5% were native, including 8 endemic species, and 16.5% were introduced from other countries. Fifty-five species represented new records for the Peruvian flora. *Pseuderanthemum lanceolatum*, *Leonia glycycarpa* and *Piper reticulatum* obtained the highest use values (UV). The most represented and culturally important families were Acanthaceae, Piperaceae and Rubiaceae. Poisonous bites and stings, infections, and pregnancy and childbirth disorders were the most common categories of conditions recorded. The majority of the medicinal plants used were wild (85.1%) and collected from the surrounding environment (80.3%).

The 79 neglected species that had not been previously reported or were rarely cited for their medicinal use or phytochemical analysis were distributed over 60 genera and 42 botanical families, with Acanthaceae being the most represented. Leaves were the most frequently used plant part (93.56%). Of the 79 species, the therapeutic activities most commonly reported involved pregnancy and birth disorders (13.84%), followed by poisonings, infections, and infestations. External application was the predominant form of use (87%). The results of this study demonstrate the gap in the documentation of traditional knowledge in Purus Province, suggesting that further studies on the traditional use of wild plant resources could provide important insights into ecosystem diversity with implications for human ecology and the conservation of biocultural diversity in the Central Amazon.

Keywords: ethnobotany, ethnomedicine, indigenous health, Peru, traditional knowledge

Resumen

Los pueblos indígenas y sus conocimientos tradicionales son esenciales en los esfuerzos mundiales para preservar la naturaleza, evaluar los métodos científicos y alcanzar los Objetivos de Desarrollo Sostenible esbozados en la estrategia de la Agenda 2030 de las Naciones Unidas. Esta tesis doctoral investiga y presenta nuevas perspectivas sobre el conocimiento botánico tradicional de las plantas medicinales del grupo étnico Cashinahua en una de las regiones más biodiversas del mundo, la provincia de Purús de la Amazonía peruana. Esta región permanece en gran medida inexplorada en cuanto al conocimiento etnobotánico que poseen los grupos étnicos locales debido a su remota ubicación y difícil accesibilidad. El objetivo general del presente estudio doctoral fue documentar el uso tradicional de plantas medicinales en las comunidades rurales Cashinahua a través de un inventario de las especies de plantas utilizadas para la medicina en la zona de estudio; el registro de los conocimientos etnobotánicos, incluidos los modos de preparación y administración; la documentación del sistema tradicional de fitomedicina Cashinahua y la identificación de posibles especies de plantas medicinales desatendidas y aplicaciones etnofarmacológicas.

La investigación de campo abarcó 11 meses entre noviembre de 2010 y junio de 2015, cubriendo varias estaciones en comunidades del grupo étnico Cashinahua en el curso superior del río Curanja. Antes de cualquier actividad de investigación, se obtuvo el consentimiento informado de los jefes de las comunidades. Los datos se recopilaron mediante una combinación de observación participante y entrevistas semiestructuradas con 20 encuestados (10 hombres y 10 mujeres) considerados especialistas en el conocimiento de las plantas medicinales de su comunidad. El 75% de los encuestados tenían entre 60 y 80 años. Además, en cuatro de las cinco comunidades estudiadas, se realizaron entrevistas semiestructuradas en hogares a 68 miembros de la comunidad (35 hombres y 33 mujeres) con una media de edad de 41,2 años. Este segundo conjunto de datos pretendía registrar el conocimiento práctico del uso de las plantas medicinales locales desde la perspectiva de los miembros de la comunidad. Además, incorporaba datos demográficos, aspectos esenciales de la salud, actitudes, percepciones y tendencias de uso.

Se compararon todos los estudios etnobotánicos pertinentes realizados en la Amazonia peruana y las regiones vecinas de Brasil y Bolivia con las especies de plantas medicinales presentes en nuestra zona de estudio. Luego se calcularon índices etnobotánicos cuantitativos para analizar el conocimiento tradicional de los informantes y determinar el significado cultural de ciertas plantas medicinales. Para comparar la diversidad de especies utilizadas por los distintos grupos étnicos, se calcularon los índices de similitud de Jaccard. Se llevó a cabo un análisis de solapamiento de plantas medicinales, seguido del cálculo del Factor de Consenso de los Informantes para examinar la coherencia de los conocimientos etno-médicos. Además, se realizó una revisión de la literatura indexada en Web of Science de 2018 a 2022 para cruzar las aplicaciones etnofarmacológicas, farmacológicas y fitoquímicas. Con base en este criterio, se identificó una selección de 79 especies que no han sido registradas previamente o solo han sido reportadas con poca frecuencia para fines medicinales o farmacológicos.

Se documentaron 467 plantas medicinales, pertenecientes a 253 géneros y 99 familias botánicas. De los taxones identificados a nivel de especie, el 83,5% eran nativos, incluidas 8 especies endémicas, y el 16,5% eran introducidos de otros países. Cincuenta y cinco especies representaban un nuevo registro para la flora peruana. *Pseuderanthemum lanceolatum*, *Leonia glycycarpa* y *Piper reticulatum* obtuvieron el mayor valor de uso (UV). Las familias más representadas y de mayor importancia cultural fueron Acanthaceae, Piperaceae y Rubiaceae. Las mordeduras y picaduras venenosas, las infecciones y los trastornos del embarazo y el parto fueron las categorías más comunes de afecciones registradas. La mayoría de las plantas medicinales utilizadas eran silvestres (85,1%) y recolectadas en el entorno cercano (80,3%).

Las 79 especies de las que no se había informado anteriormente o que rara vez se citaban por su uso medicinal o análisis fitoquímico estaban repartidas en 60 géneros y 42 familias botánicas, siendo Acanthaceae la más representada. Las hojas fueron la parte de la planta más utilizada (93,56%). De las 79 especies, las actividades terapéuticas más citadas fueron los trastornos del embarazo y el parto (13,84%), seguidos de las envenenamientos, las infecciones y las infestaciones. La aplicación externa fue la forma de uso predominante (87%). Los resultados de este estudio demostraron el vacío existente en la documentación de los conocimientos tradicionales en la provincia de Purús, lo que sugiere que nuevos estudios sobre el uso tradicional de los recursos de plantas silvestres podrían proporcionar importantes conocimientos sobre la diversidad de los ecosistemas con implicaciones para la ecología humana y la conservación de la diversidad biocultural en la Amazonia Central.

Palabras claves: etnobotánica, etnomedicina, salud indígena, conocimientos tradicionales, Perú

Abstrakt

Domorodé národy a jejich tradiční znalosti jsou považovány za klíčové součásti celosvětového úsilí o ochranu přírody, hodnocení přístupů v oblasti vědy a dosahování globálních cílů udržitelného rozvoje v rámci strategie OSN Agenda 2030. Tato disertační práce přináší nové poznatky o tradičním užívání léčivých rostlin etnikem Cashinahua v jedné z druhově nejrozmanitějších oblastí naší planety, v provincii Purus v peruánské Amazonii, kde byly z důvodu odlehlosti a obtížné dostupnosti regionu etnobotanické znalosti původních obyvatel dosud z velké části neprozkoumány. Celkovým cílem této doktorské studie bylo zdokumentování tradičního používání léčivých rostlin ve venkovských komunitách Cashinahua formou inventarizace rostlinných druhů používaných ve studované oblasti k léčení, zaznamenání etnobotanických znalostí, včetně způsobů přípravy a podávání rostlin, dokumentace tradičního systému Cashinahua léčitelství a určení potenciálně opomíjených druhů a jejich využití v etnofarmakologii.

Terénní výzkum probíhal v 5 Cashinahua komunitách na horním toku řeky Curanja po dobu 11 měsíců v různých ročních obdobích od listopadu 2010 do června 2015. Informovaný souhlas byl získán před zahájením výzkumné činnosti od náčelníků vesnic. Data byla zaznamenána na základě zúčastněného pozorování a polostrukturovaných rozhovorů 20 respondenty (10 muži a 10 ženami) považovanými svou komunitou za specialisty ve znalosti a používání léčivých rostlin. Sedmdesát pět procent dotazovaných bylo ve věku od 60 do 80 let. Ve čtyřech z pěti zkoumaných komunit byly dále vedeny polostrukturované rozhovory v domácnostech s 68 členy komunity (35 muži a 33 ženami) o průměrném věku 41 let. Tento druhý soubor dat se soustředil na zdokumentování praktických znalostí užívání léčivých rostlin z pohledu členů komunity. Kromě toho zahrnuje demografické údaje zúčastněných, informace o prodělaných nemocech a způsobu jejich léčení a postojích k tradiční léčbě í.

Druhy léčivých rostlin zaznamenané během výzkumu byly porovnány s etnobotanickými studiemi uskutečněnými v peruánské Amazonii a v přilehlých oblastech Brazílie a Bolívie. Pro posouzení tradičních znalostí informátorů a určení kulturního významu některých léčivých rostlin byly následovně provedeny výpočty etnobotanických indexů a pro porovnání rozmanitosti druhů používaných srovnávanými etnickými skupinami vypočteny Jaccardovy indexy podobnosti. Analýza překryvu léčivých rostlin a faktor shody informátorů posloužil k posouzení konzistentnosti etno-medicínských znalostí. Pro vzájemné porovnání údajů o případném etnofarmakologickém či fytochemickém výzkumu týkajícího se studovaných rostlin byla v závěru práce provedena revize literatury publikované na Web of Science v letech 2018 až 2022. Na základě tohoto kritéria bylo identifikováno 79 druhů rostlin, které nebyly ve vědecké literatuře zaznamenány, anebo byly v etnofarmakologickém či fytochemickém kontextu uvedeny jen výjimečně.

V této studii je popsáno 467 léčivých rostlin, které se řadí do 253 rodů a 99 botanických čeledí. Z taxonů identifikovaných do úrovně druhu je 83,5 % v Peru původních, včetně 8 endemických druhů, a 16,5 % je zavlečených. Nový záznam pro peruánskou flóru představuje 55 druhů. Nejvyšší užitnou hodnotu (UV) prokázaly *Pseuderanthemum lanceolatum*, *Leonia glycycarpa* a *Piper reticulatum*. Z čeledí jsou nejpočetněji zastoupeny Acanthaceae, Piperaceae a Rubiaceae. Mezi nejčastěji citované kategorie zdravotních problémů se řadí hadí uštknutí, následované infekcemi a potížemi týkajícími se těhotenství a porodu. Většina používaných léčivých rostlin byla planě rostoucí (85,1 %) a byla sbírána v blízkém okolí (80,3 %).

Sedmdesát devět druhů, které nebyly dosud ve vědecké literatuře zmíněny, bylo zařazeno do 60 rodů a 42 botanických čeledí, z nichž nejčastěji zastoupenou byla čeleď Acanthaceae. Nejčastěji používanou částí rostliny byly listy (93,56 %). Uvedené léčebné použití se týkalo především problémů a prevence v těhotenství a při porodu (13,84 %), následovala hadí uštknutí a infekce. Převládající formou použití byla zevní aplikace (87 %). Výsledky této studie ukazují na rezervy v dokumentování tradičních znalostí v provincii Purus a naznačují, že budoucí studie tradičního využívání zdrojů planě rostoucích rostlin by mohly poskytnout informace důležité pro pochopení rozmanitosti ekosystémů, což by mělo vliv na ekologii člověka a zachování biologické a kulturní rozmanitosti v centrální Amazonii.

Klíčová slova: etnobotanika, etnomedicína, zdraví původních obyvatel, tradiční znalosti, Peru

1. Introduction

The earliest forms of life on Earth were of plant origin. Plants provided the foundation for the evolution of increasingly complex life forms culminating in the animal kingdom, which includes humans. The Earth's verdant canopy has a remarkable synergy with the sun: it captures the sun's rays to manufacture fundamental organic compounds essential to the survival of plant and animal life. In this manner, solar energy permeates the planet, being stored in plant matter as chemical energy which underpins all biological processes. The plant kingdom not only supplies nourishment for our body and energy to meet our daily requirements, but also contains crucial vitamins that facilitate metabolism as well as active compounds employed in medicines (Schultes and Hofmann 1982).

Tropical forests are the oldest, most complex, and most important terrestrial environments on the planet. They account for a third of land-surface productivity and evapotranspiration and are home to over half of the world's plant and animal species according to Malhi et al. (2014). The biodiversity of medicinal species in the Amazon, as a natural source, offers essential therapeutic properties and bioactive compounds that promote human health. Traditional medical systems, especially herbal remedies, have a considerable influence on healthcare in many developing nations where financial constraints limit access to modern medicine (Nair et al. 2018). Nevertheless, indigenous communities and cultures face rapid environmental, socio-economic, and cultural changes that affect their healthcare practices. Significant amounts of traditional medical knowledge, considered a form of intangible cultural heritage, are vanishing without being documented, researched, or verified by science (Quave et al. 2012).

Although the indigenous population of the Amazon gravitates towards traditional medicine, barriers such as the remoteness of health facilities, financial constraints, and lack of access to government-provided health care make it very difficult to access doctors when needed (Brierley et al. 2014). The population remains reliant on available natural medicine remedies. These problems appear to be exacerbated when indigenous populations live in remote rural communities that are difficult to reach (Giovanella et al. 2015). This is true for the Cashinahua, a small indigenous Panoan group living on the border between Peru and Brazil. They reside in a remarkably remote and ecological varied region of the Peruvian Amazon, in the river basin of Alto Purus.

Purus Province is an indigenous territory with inhabitants from the Panoan and Arawakan linguistic families, where around 80% of the population is indigenous, therefore making this watershed an epicentre of cultural diversity. The Cashinahua are the largest ethnic group among at least eight living in the province. A key advantage, both from the point of view of a suitable research site and from the point of view of nature conservation, is the isolated and inaccessible nature of the region, specifically the study site along the upper reaches of the Curanja River, which greatly limits the presence of non-local inhabitants. The Curanja River – a left tributary of the Alto Purus River – serves as the buffer zone of the country's largest natural park and is exclusively inhabited by the Cashinahua across seven distinct communities. Medicinal plant species used in traditional Peruvian Cashinahua folk medicine have been under-documented, scientifically unrecognized, and excluded in the current scientific literature. According to our knowledge, there are no publications or studies documenting data on medicinal plant use in Purus Province apart from the works of James Graham (Graham 2001a). Although international literature sources provide limited information on medicinal plant use in Purus Province (Graham 2001a), publications suggest evidence of medicinal plant use among members of a neighbouring ethnic group, the Kaxinawa of Acre State, Brazil (de Almeida et al. 2023; Ehringhaus 1997; Manduca et al. 2014).

The Cashinahua tribe made contact with the outside world in the late 1940s, after having spent several generations in voluntary isolation in the depths of the rainforests surrounding the Curanja River watershed. Access to Western medicines and the arrival of Christian missionaries since the 1950s has contributed to the rejection of socio-cultural knowledge on the use of some traditionally utilised medicinal plants (Kensinger 1998a). Within a few generations, the Cashinahua have gone from being almost entirely self-sufficient and isolated to becoming increasingly dependent on the outside world for highly valued and essential goods, including medicines (Graham 2001a). The last 70 years have witnessed the disregard or even oppression of indigenous beliefs, traditions, and practices, ultimately leading to a substantial depletion of traditional knowledge (Reiter and Camargo 2023). During this period, access to traditional medicine and the practices of local healers were limited and concealed. To prevent further decline in Cashinahua traditional knowledge, which is facing threats from substantial depopulation and anthropogenic impacts, there is an urgent need for ethnobotanical studies to document local knowledge, analyse collection-use patterns, and identify traditional medicinal plant species.

The study was conducted as a part of a long-term project of the Universidad Nacional Intercultural de Amazonía in partnership with the Czech University of Life Sciences in Prague. The implemented methodology incorporated field research, scientific data analysis, and an applied intervention to facilitate desired outcomes. This thesis seeks to gain a better understanding of the relationship between medicinal plants and Cashinahua communities within the context of their biological and socio-cultural environment. The research was based on insights provided by accomplished Cashinahua herbalists. A comprehensive record of the medicinal uses of all collected species was produced in the Cashinahua language (*Hantxa Kuin*) and presented in hard copy to all key informants to ensure that they had access to this vital information. Workshops were also conducted with schoolchildren residing in the communities, requesting illustrations and the labelling of the medicinal plants recognised by them.

The main objective of this thesis was to gain insight into the relationship of Cashinahua communities with medicinal plants in the context of their biological and socio-cultural environment. This study aimed to: (1) document the traditional use of medicinal plant species used by Cashinahua people employing standard ethnobotanical methods, (2) document the traditional system of Cashinahua phytomedicine, and (3) identify potentially neglected medicinal plant species and ethnopharmacological applications. The specific aims within those objectives and research questions are provided later in Chapter 3.5, Objectives and research questions.

2. Background

2.1. Peru: a biodiversity hotspot

Although there are an estimated 8.7 million species currently on Earth (Mora et al. 2011; Sweetlove 2011), their distribution is highly concentrated in certain areas. In the late 1980s, Norman Myers, a British environmentalist specialising in biodiversity, developed an initial characterisation of the highly influential concept of 'hotspot' areas of biodiversity, with the aim of shedding light on the mass extinction of the Earth's species (Myers 1988). He initially included ten of these areas, characterised as a biogeographical region with exceptional levels of biodiversity that is threatened by human settlement. In this first introduction, he included the Peruvian Amazon, as part of the larger complex of the Western Amazon Uplands, among the ten discrete areas of tropical forest considered 'hot spots' because of their floristic richness and deforestation rates. The study area has therefore been part of these highly important areas for biodiversity conservation since their inception. The 10 hotspots covered an area of 292,000 km2, representing only 3.5 per cent of primary tropical forest, but contained endemic plant species representing 27 per cent of all tropical forest plant species (Myers 1990). Twenty-five regions were subsequently identified as biodiversity hotspots on Myers’ 2000 edition of the hotspot map (Myers et al. 2000). Since then, the concept has been revised several times and continues to be modified from time to time, now by Norman Myers’ successors, to the current 36 hotspots.

Biodiversity hotspots, recognized as significant geographical areas (Myers et al. 2000), are vital for the protection of biodiversity. Megadiverse countries, such as Bolivia, Brazil, China, Colombia, Costa Rica, the Democratic Republic of the Congo, Ecuador, India, Indonesia, Kenya, Madagascar, Malaysia, Mexico, Peru, the Philippines, South Africa, and Venezuela, hold particular significance in this respect (Brooks et al. 2002). Peru is ranked seventh in this category, due in large part to the presence of a wide range of climates (28 out of the 32 climates found on Earth) within its borders. Biodiversity in Peru is on the rise, with the number of species of wild flora having increased to a total of 20,585. This trend shows a positive shift towards greater ecological diversity in the region. However, the IUCN Red List denotes a rise in endangered species as well (IUCN 2022). Covering 84 of the world's 107 ecoregions, Peru was estimated, in 1993, to have 17,143 taxa of spermatophytes in 2,485 genera and 224 families, of which 30% are endemic (Brako a Zarucchi 1993). Most of the native species are wild, while approximately 1,922 are cultivated, and only 222 can be considered domesticated or semi-domesticated (Egg 1999). The importance of biodiversity for the Peruvian economy is enormous, since 25% of all exports are living species. Around 65% of the country's agriculture is based on native plants, and around 95% of Peru's livestock production is based on native fodder plants. It is estimated that the use of plants is worth around $4 billion a year, or an average of $200 per person (Egg 1999).

2.2. Biocultural diversity of the Peruvian Amazon

Biodiversity covers the complete range of life forms, including variations among individuals and populations within a species, as well as the diverse species found in a community or ecosystem. Furthermore, it encompasses the extensive variety of species groups within an ecosystem regarding their roles, as well as the range of ecosystems themselves (Hanley and Perrings 2019).

The Amazon wilderness area is the largest undisturbed tropical forest remaining in the world (Myers et al. 2000). The Amazon basin in Peru boasts an exceptional wealth of biodiversity, surpassing that of any other region globally. This profusion of species and habitats provides vital ecological advantages to the area, including carbon sequestration, regulated water cycles, essential means of subsistence for native communities, and medicinal resources. Topography variations, adequate precipitation, and perpetual warmth in the region have facilitated this biodiversity. Furthermore, the abundance of rivers and their tributaries in the Amazon region produces distinct ecosystems, each supporting its own unique ecological communities (Pitman et al. 2003).

Peruvian tropical rainforests contain 23% of all known tropical plant taxa (IUCN 2022), which constitutes the largest collection of vascular flora in Peru (Ulloa Ulloa et al. 2017). This diversity represents the primary source of food, medicine, energy, crafts, dyes, fibres, art, rituals, and symbols for human groups inhabiting the Amazon (De-la-Cruz et al. 2007). With such extensive biodiversity, it is surprising how small a percentage of these plants have thus far been scientifically studied. Graham (2003) asserts that an absence of regionally consistent data is common in the Amazon, and this poses a challenge to ethnobotanists and ethnobiology trying to address this important lack of continuity.

2.2.1. Indigenous cultures of the Peruvian Amazon

According to the National Institute of Statistics and Informatics (INEI 2018), one third of the Peruvian population in Peru is indigenous. Most individuals belong to the Quechua and mestizo ethnic groups, representing 79% of the total population. Notably, a mere 1% of the Peruvian population identify themselves as members of an Amazonian ethnic group (Aparicio and Bodmer 2009a). Although the Amazon rainforest covers more than half of Peru (57.9%), its population density is very low. Only 2.2 million people, making up just 9% of the country's population, inhabit the region. Overall, the estimated total population of indigenous Amazonians is close to 300,000 individuals (Smith et al. 2003). In the Peruvian Amazon, there are over 50 distinct indigenous groups, consisting of 12 major linguistic families. As a result of a lengthy history of violence, forced migration, and invasion of traditional homelands, these groups now range in size from only a few remnant members (in the case of the Andoas, Resigaro, Taushiro, and Andoque) to an estimated 50,000 people (in the case of the Aguaruna and Ashaninka) (Smith et al. 2003). This culturally diverse environment is home to indigenous people who rely on natural resources for their livelihoods and access to medicinal plants that have supported their health for centuries. For Peruvian indigenous groups, understanding plants is crucial to maintaining ethnic identity and values that may be threatened by modernisation and globalisation (Bussmann and Sharon 2015).

One of the 12 linguistic families is the Pano language family, which is well known in the lowlands of South America, along with the Arawak, Tupi, Karib, and Tukano families. Presently, approximately twenty-five languages from this family are spoken in the border regions of the Amazonian forests of Peru, Brazil, and Bolivia. The Pano population in the Peruvian Amazon consists of approximately 40,000 individuals, including the Amahuaca, Capanahua, Cashibo Cacataibo, Cashinahua, Mayoruna, Nahua, Sharanahua, Shipibo-Conibo, and Yaminahua groups (Aparicio and Bodmer 2009).

2.3. Peruvian Amazon under threat

Within tropical forests, the western Amazon holds considerable conservation value, owing to its exceptional biological diversity (Ceballos and Ehrlich 2006; Young et al. 2005) and cultural richness (Killeen 2007), as well as lower levels of land conversion in comparison to the eastern Amazon (Finer et al. 2008). The Amazon rainforest is vulnerable to the impacts of climate change, including changes in rainfall patterns, extreme temperatures, droughts, floods, and fires. Moreover, climate change has the potential to exacerbate other threats such as deforestation, diseases, and invasive species. These impacts may influence the ecological functioning and resilience of ecosystems, leading to alternations in their biodiversity and services (Posey 1996; Sánchez-Cuervo et al. 2020). Despite the remarkable diversity of the region, various species and habitats in the Amazon face a host of challenges. In particular, habitat destruction, the introduction of non-native species, and climate change represent threats to current and future biodiversity, underlining the pressing need for conservation efforts aiming to maintain the ecologically vital services provided by Amazonian forest ecosystems. Between 2001 and 2017, deforestation led to the depletion of over 3 million ha of forest, primarily owing to the expansion of infrastructure, agriculture, mining, and logging activities.

During the COVID-19 pandemic lockdowns, there was a significant surge in deforestation. In Brazil, the deforestation rate increased by 72% between August 2019 and May 2020, compared to the previous year, resulting in over 1.3 km^2 of deforestation every hour (Escobar 2020). This situation is not inevitable. For instance, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) was able to decrease deforestation in the country by 80% from 2004 to 2012 through satellite surveys and on-the-ground enforcement (Spring and Eisenhammer 2019). However, some governments have exploited the pandemic as a cover to weaken regulations and reduce the staff and operating funds of crucial government organisations (Daly 2020). The Peruvian Amazon is a complex and dynamic socio-ecological system that requires efficient and participatory governance to preserve it. However, the legal, institutional, and political frameworks that govern the use and management of natural resources in the region are fraught with gaps and conflicts. There is also insufficient coordination and collaboration among various stakeholders and actors, including Indigenous communities, governmental agencies, NGOs, and the private sector.

2.4 Neglected tropical diseases in Peruvian Amazon

The World Health Organization (WHO) defines neglected tropical diseases (NTDs) as a diverse group of communicable diseases that prevail in tropical and subtropical conditions in 149 countries (WHO 2022). International Centre for Insect Physiology and Ecology reports that NTDs are a group of parasitic and bacterial infectious diseases that occur in tropical and subtropical regions in 149 countries. They affect over a billion people and cost developing economies billions of dollars annually. These diseases cause immense human suffering and long-term disability. NTDs are responsible for more than 500,000 deaths each year. A diverse range of 20 diseases are currently included. They flourish mainly in rural areas, conflict zones, and hard-to-reach regions (WHO 2022). Neglected tropical diseases primarily affect marginalized communities without access to proper healthcare. Examples include dengue, malaria, leishmaniasis (Molyneux 2014) and snakebite (since 2017).

Envenoming from venomous animal bites is a serious public health issue in Latin America. In 2017, snakebites were re-added to the list of neglected tropical diseases by the World Health Organization (Bhaumik et al. 2018b) due to their frequent occurrence in remote rural areas, and the threat to life because of the absence of the possibility of reaching conventional medical help in the critical period after a bite. Snakebite envenomation is an important global public health issue, especially in tropical areas, due to their frequency and resulting morbidity and mortality (Magalhães et al. 2019); globally, an estimated 81,000–138,000 people a year die from snakebites. Several recent studies have demonstrated that the most affected group is mainly composed of men working in rural areas, and that snakebites occur mainly during the day, most frequently involve the lower limbs, and are mostly caused by the *Bothrops* genus, which is also the case in South America (Gutiérrez et al. 2017). Recognising the impact of poisonings on vulnerable population groups, the importance of the species used to treat snakebites and their symptoms should be highlighted.

Despite being prevalent in neighbouring areas, snakebites are not identified as a frequently reported ailment (Alexiades 1999a; de Almeida et al. 2023a; Odonne et al. 2013; Sanz-Biset et al. 2009). The specific biological conditions of Purus Province, which is geographically isolated and boasts a largely unspoiled rainforest, likely account for this phenomenon. One of the region's distinguishing characteristics is its high density of reptiles. Venomous snakes, which are abundant because of the incredible diversity of flora and fauna, pose a significant threat to human life (Horackova et al. 2023). Snakebites are not mentioned as a prevalent health issue in the Ucayali region by the Ministry of Health since the risk of snakebite is negligible in urban areas that have access to medical care. However, they pose a severe threat to life in isolated rural communities. Given the substantial distance of the study site from any access to conventional medical care in the event of snake or venomous insect bites, it is crucial to have knowledge of plants for both initial first aid and subsequent treatment. Section 5.3.1 discusses in detail the remedies for venomous bites and the flora used to obtain them.

Scorpion stings also fall into the same category of venomous bites. In numerous global regions, scorpion stings are a severe health concern that is frequently disregarded. Since many affected individuals do not obtain medical treatment, the actual prevalence of scorpion sting envenomation remains unknown. Nevertheless, it has been determined that roughly one million stings occur annually (WHO 2007). Autonomic nervous system mediators, released by scorpion venom, may result in myocardial damage, cardiac arrhythmias, pulmonary oedema, shock, muscle spasms, paralysis, and pancreatitis, which can all prove fatal, particularly in young children. Early administration of antivenom alongside intensive care support proves markedly effective (Laraba-Djebari et al. 2015).

Leishmaniasis was recently re-added to the list of neglected tropical diseases by the World Health Organization (Bhaumik et al. 2018a). The Pan American Health Organization highlights that leishmaniasis is one of the top ten neglected tropical diseases worldwide, with over 12 million people infected. Of the nine countries that report 85% of the cases, three are located in the Americas, including Peru, where CL (cutaneous leishmaniasis) is an endemic disease. The prevention and control options available for CL are limited. ICIPE (2024) acknowledged that successful vector control is crucial for the management of several arthropod-transmitted NTDs. These include leishmaniasis, dengue fever and malaria.

2.5. Socio-economic context of Purus Province

The economy of Purus primarily relies on activities within the primary sector, including agriculture, hunting, fishing, and forestry (Ministerio de Salud del Perú 2019). Presently, data and information concerning the economic and social state of Purus is scarce (Vargas 2019). In Ucayali, monetary poverty has only been documented at the departmental level, and it is substantially lower than the national average, likely as a result of the increased number of inhabitants without access to a basic food basket (Ministerio de Salud del Perú 2009). In the Ucayali region, there is a significant level of social inequality. This disparity is particularly evident in the province of Purus, where the Regional

Government’s investment is comparatively small in comparison to other provinces (Vargas 2019). In Purus, investment is primarily concentrated in the city of Puerto Esperanza, with a decline in funding for Indigenous communities. The area’s overall quality of life is below average and there is insufficient social cohesion between the Mestizo and Indigenous communities. Notably, the latter group accounts for 96% of Purus Province’s population (Gobierno Regional de Ucayali 2016).

Access to basic services such as electricity, drinking water, and education remains difficult in Purus Province, while access to basic foodstuffs is severely limited due to the lack of transport and access to roads (Dirección Regional de Trabajo y Promoción del Empleo de Ucayali 2020). The insufficient connectivity between Purus Province’s provincial capital, Puerto Esperanza, which is located in a border region, and other cities is the primary reason for the province’s underdevelopment. The underdeveloped transport sector impedes the provision of essential services and the growth of the economy. As a result, the inhabitants of Purus have a poor quality of life (Vargas 2019). The income level of the province’s inhabitants is well below that of Ucayali and the national average. The average annual income per family in Purus is PEN 1525.22 (USD 418) (Ministerio de Salud del Perú 2019). The per capita family income in the province of Purus, according to the 2019 Ucayali Region Socioeconomic Labor Diagnosis, is 551.7 PEN (151 USD). However, these statistics do not consider the remote communities that are unable to sell their products. Therefore, apart from the few elderly individuals reliant on Pension 65, there is no monetary income within these communities. Only teachers and government officials receive a regular salary from the government (Vargas 2019). There is a lack of paid employment opportunities within the province, and most Indigenous individuals residing in these communities are without any form of monetary income. Accessibility to necessary goods and medical care within a community becomes more difficult with increasing distance from Puerto Esperanza, the sole provider of these services in the province. This is the only place in the province where there is access to goods, medicine, and petrol for the journey back to the village. In isolated communities, there are no means of obtaining funds for essential items, such as salt, soap, ammunition, and torch batteries, unless through the occasional sale of hunted animals or crops. This situation illustrates why an increasing number of Indigenous peoples from remote areas are relocating downstream to Puerto Esperanza, even though they are unable to cultivate crops for sustenance, hunt animals, or secure employment. The population growth rate in Purus Province is decreasing, likely as a result of the province's low socio-economic development, which could be causing an increase in migration to Brazil and other larger cities within Peru, such as Pucallpa (Ministerio de Salud del Perú 2009). This situation inevitably affects all related aspects, such as education, the provision of basic needs for people who live mainly in remote areas, infrastructure, and health care. This is evidenced by Cashinahua families migrating to the Brazilian side of the border, where they benefit from better economic opportunities.

2.5.1. Access to healthcare

Access to health services for the Indigenous community in Purus Province faces significant barriers. The area's distance from urban centers, along with the high cost of fuel and the scarcity of boats with outboard motors, exacerbates the issue. Six state facilities provide healthcare services in the province. Five of the six rural health posts that exist in the province are in Indigenous communities, while the remaining facility is a health center in Puerto Esperanza. Additionally, access to healthcare is provided through the Brigade for Integrated Health Care for Excluded and Dispersed Populations (AISPED), community health promoters, and Indigenous healers, otherwise known as herbalists or specialists. Only the Purus Health Centre in Esperanza has the benefit of professional staff and a laboratory, albeit currently unstaffed (Ministerio de Salud del Perú 2019). The Curanja River, which is home to seven exclusively Cashinahua communities, boasts two medical posts. In every Indigenous community, there is a health promoter who is trained in administering basic medicines for common afflictions such as pain, fever, diarrhoea, and colds. The promoter facilitates the transfer of available medicines from the community health kit (botiquín de la comunidad) upon request. The insufficient availability of medication, among other issues, has resulted in numerous grievances from FECONAPU, the organisation advocating for the welfare and interests of the Indigenous populations residing in Purus (Ministerio de Salud del Perú 2019).

The Indigenous communities living in Purus Province represent a marginalised group, lacking access to adequate healthcare because of misconceptions, inequalities based on ethnicity, and geographic remoteness, which heightens their vulnerability to acute health problems such as gastrointestinal issues, infections, injuries, and snakebites. In the first instance, the Indigenous population prefers to use their traditional means of treatment, which may be influenced by difficulties in accessing health services. Consequently, patients may arrive at medical facilities with aggravated symptoms, which poses a significant hazard especially for minors. Despite the implementation of community involvement strategies within the Peruvian healthcare system to improve Indigenous community health care, the absence of resources, staff, and cultural awareness impedes success. These barriers create challenges in providing effective care to this population. Consequently, it is critical to comprehend how Indigenous communities in the central Peruvian Amazon employ both traditional therapies and official health resources to manage their health problems (Badanta et al. 2020).

Research indicates that traditional healers remain the primary providers of health services for the vast majority of Indigenous people in the Amazon (Jauregui et al. 2011).

2.5.2. Health care options for Indigenous communities

The delivery of healthcare services to Indigenous communities is subject to various challenges, including language barriers, cultural differences, and diverse health needs. According to official statistics, the Peruvian Amazon is home to 372,000 Indigenous people, representing 93% of the 55 Indigenous groups living in Peru (INEI 2018). These Indigenous communities face significant social inequality, experiencing higher infant mortality rates, limited access to healthcare, and a lower nutritional status compared to the wider population (Anderson et al. 2016; Terán-Hernández et. al 2016). In this population, significant inequality has been identified as a contributing factor to a range of health issues, particularly in the form of a higher incidence of gastrointestinal problems (Bradford et al. 2016), infectious diseases such as tuberculosis (Lafontaine 2018), and poor oral health (Schuch et al. 2017). Although on its website the Ministry of Health in Peru (MINSA) asserts that by 2020 the citizens of Peru will receive complete physical, mental, and social healthcare through state intervention based on the principles of universality, equity, solidarity, a focus on the right to health, and interculturality, the situation of Indigenous peoples in remote and rural areas has yet to improve. A Peruvian health information system (SIS) is a mechanism that collects, processes, analyses, and transmits information to organise and operate health services, research, and disease control management. Nevertheless, the SIS encounters challenges of geographical isolation in certain areas, as well as insufficient investment in human resources, infrastructure, and equipment. Because of these limitations, the SIS cannot accurately document data, thus hindering the accuracy of its statistics regarding health issues among certain population groups. Additionally, data received from the initial level of care varies in quality due to differing socio-economic conditions, organisational and administrative capacities, and service delivery capabilities that influence the quality of the generated information (Palma-Pinedo and Reyes-Vega 2018). It should be noted that the Peruvian government does not separate data by ethnicity, which limits the information available on the population living in the rainforest (Llanos et al. 2019). The data published by MINSA (Ministerio de Salud del Perú 2019) is derived from consultations and examinations conducted in its health facilities, which renders it unsuitable for Indigenous communities residing in remote rural areas. These communities rely on traditional medicine and do not generally visit medical facilities as stated earlier (Badanta et al. 2020).

2.5.3. Level of education in Purus Province

The introduction of the national education system, mainly via bilingual schools, into Indigenous villages has adversely impacted traditional culture, as these schools in Peru and Brazil do not conform to local socio-cultural or linguistic norms. Unfortunately, they hold a perception of knowledge and its dissemination founded on nationwide cognitive conceptualisation models, contradicting the perspective held by the majority of Amazonian communities and consequently impacting the worldview of younger generations (Reiter a Camargo 2023).

The illiteracy rate in Purus has steadily declined. Nevertheless, it is crucial to mention that the 2017 illiteracy rate in Purus was still three times higher than the average rate in the Ucayali region as well as the national level, highlighting the existing disparity. On the basis of the findings of the latest census, 72% of the residents of Purus Province possess literacy skills, while the remaining 28% lack the ability to read and write (Ministerio de Salud del Perú 2009). According to the latest census, 20% of the Purus population lack any formal education, whereas 46% have attained some level of primary education and 26% have reached a secondary education level. The proportion of those holding non-university and university higher education qualifications is only 2%. One-third of registered pupils do not progress further because of various factors such as academic failure or dropping out. Most rural schools are located within Indigenous communities, and these communities account for 79% of the total primary school population. In 2018, Purus had 84 educational institutions, of which 38 were primary, 33 were pre-school, 9 were secondary, and 2 were higher education and basic alternative schools. UGEL Purus registered these schools as bilingual, despite a significant proportion lacking Indigenous teachers. The majority of teachers in primary schools were bilingual; however, most bilingual schools lacked materials in the vernacular language. Aside from the lack of equipment and teachers, teacher absenteeism also impacts education (Ministerio de Salud del Perú 2009).

2.6. Purus Province

2.6.1. Flora

Located in the Ucayali and Madre de Dios departments, in one of the most remote and inaccessible parts of the Peruvian Amazon, the Alto Purus region has been identified as a conservation priority both nationally and internationally because of its abundance of endangered flora and fauna. In 2004, the Peruvian government made significant progress in conserving the area by establishing the 2,510,694 ha Alto Purus National Park and the 202,033 ha Purus Communal Reserve. The newly established park is now the largest in Peru and links the 1.7 million ha Manú National Park to the south with Brazil's 670,000 ha Chandless State Park to the east, creating the largest stretch of completely protected land in the Amazon basin. This vast area is approximately the size of Costa Rica (Pitman et al. 2003).

Pitman et al. (2003) considers the vegetation type of Purus Province to be identical to Amazonian tropical forest, with no discernible differences in structure or function from the majority of forests found elsewhere in the Amazon basin. Terra firma forests constitute over 90% of the province's terrain. Upland forests cover 93.9% of the surveyed landscape and a slightly higher proportion if the rest of the Alto Purus Reserved Zone is considered (Pitman 2003). The remaining ~5% of the landscape is covered by specific forest types confined to narrow stretches along the larger rivers. On the sandy ledges formed by meandering rivers, a gradient of successional vegetation of varying ages extends from the youngest beaches, almost exclusively colonised by the shrub *Tessaria integrifolia* (Asteraceae), to the higher riparian banks dominated by the giant canebrakes of *Gynerium sagittatum* mixed with *Baccharis* (Asteraceae) shrubs, and to the young primary successional forests that begin with mainly *Cecropia membranacea* (Cecropiaceae) trees. The three main types of vegetation that grow alongside the larger rivers in the area can be distinguished and are separate from primary succession: i) swamps dominated mostly by *Mauritia flexuosa* palms (Arecaceae) or *Ficus* (renaco; Moraceae); ii) alluvial forests subject to frequent flooding, with a canopy comprised of large, old *Calycophyllum spruceanum* (Rubiaceae) and *Calophyllum brasiliense* (Calophyllaceae), and an open understory of *Heliconia* (Heliconiaceae) and *Calathea* (Marantaceae); and iii) alluvial woodlands, which are relatively unaffected by flooding due to their elevation and position relative to the river, consisting of tree communities that are similar in composition and structure to those found in upland forests (Pitman et al. 2003).

Scattered among these are other typical sandbank herbs and shrubs of the Asteraceae, Cyperaceae, Euphorbiaceae, Malvaceae, Onagraceae, Poaceae, Phytolaccaceae, and Solanaceae families, with a characteristic component of Convolvulaceae vines. Human intervention at village sites, gardens, and recently abandoned clearings are the only other breaks in the forest cover (Graham 2001).

The floodplain forest is punctuated by well-drained terraces and small hills that rise up to 50 m. There is a flourishing vegetation comprising arboreal layers of towering trees that can extend as high as 40 m, with branches stretching outwards for 15-20 m. These trees frequently play host to numerous additional species, including emergent canopy lianas and epiphytes. The lower layers are composed of shrubs, herbs, vines, and juvenile trees, which are frequently taken over by *Guadua* spp. This upland woodland, mainly on the slopes, is quite thick, but the understory is more open than the floodplain forest canebrakes (Graham 2001).

According to Graham (2001), the regional flora in the Peruvian department of Ucayali can only be provisionally classified because of insufficient sampling. Botanical sampling in this vast region, covering more than 100,000 km^2, recorded less than 2,000 species in 1993 (Brako and Zarucchi 1993). The inadequate sampling rate in the region prevents any estimation of species richness. The 755 samples obtained during the Graham & Schunke Vigo survey (Graham 2003) accounted for the full botanical record of Purus Province in 2001. Furthermore, the sample size can be expanded by the addition of the 590 samples obtained during the current investigation.

2.6.2. Native Amerindians of Purus

The Alto Purus River basin is an Indigenous territory inhabited by peoples belonging to the Panoan and Arawakan linguistic families. The majority of the province's population is Indigenous, making this watershed a centre of cultural diversity. At least eight ethnic groups, namely the Cashinahua, Chaninahua, Mastanahua, Sharanahua (Panoan groups which native auto denomination is *Huni Kuin*, with phonetic variations), Amahuaca (also a Panoan group), Culina, Asháninka, and Yine (Arawakan groups), comprise the communities residing in the Alto Purus River basin (Pitman et al. 2003), with the Cashinahua group being the most numerous. In addition to this region serving as a crucial and well-maintained sanctuary for endemic and endangered species in the Amazonian region, this vast and pristine wilderness is also inhabited by one of the few remaining nomadic Indigenous groups in the world who opt for an isolated way of living (Fagan and Shoobridge 2007). There is ample evidence that Indigenous communities in voluntary isolation reside in the Alto Purus Reserved Zone, the most remote region near the headwaters of the rivers that protect the last untouched areas of the planet, from where they apparently migrate throughout the area and even into neighbouring lands of Brazil (Pitman et al. 2003).

Purus Province is home to several Indigenous groups that maintain their traditional ways of life. However, this area faces multiple threats from illegal logging, mining, drug trafficking, and infrastructure projects that could endanger its natural and cultural heritage (Reiter a Camargo 2022). Indigenous people have experienced and continue to experience the effects of colonisation, small and large-scale natural resource extraction projects, and cultural developers who believe that adopting Western cultural models is necessary for recognition as citizens. While it is widely acknowledged that Indigenous groups have a longstanding presence, it is crucial to recognise their citizenship and rights, and this is an issue that goes beyond the political arena (Aparicio and Bodmer 2009).

2.7. Peruvian Cashinahua

The Cashinahua people live near the headwaters of the Juruá and Purus river systems. The former in the state of Acre in north-western Brazil, and the latter in the province of Purus in south-eastern Peru. They were first contacted in the late 19th century during the rubber boom, when they all lived in one area, the Juruá basin in Brazil. The Cashinahua ethnic group consists of around 10,000 individuals who live in an extensive region within the Brazilian-Peruvian border area. The Cashinahua language belongs to the Panoan language family, all other members of which being geographically confined to the border triangle of Peru, Bolivia, and Brazil (Reiter and Camargo 2022).

In recent years there has been a growing movement for indigenous self-determination, cultural preservation and identity recovery. Within this movement, many tribes, including the Cashinahua, are claiming their autonyms and demanding that outside groups respect and use them instead of imposed ethnonyms. Since the early 1990s, members of the ethnic groups under study on both sides of the Peru-Brazil border have used the autonym Huni Kuin, which means 'real people' or 'human beings' (Deshayes and Keifenheim 2015; Kensinger 1995; McCallum 1996). It is important to note that many other groups in the Pano language family also use this term as a self-designation. For this reason, the ethnonym Cashinahua is used in this study to refer to the group under investigation. At the same time, the use of this name makes searching for information in older literature easier for researchers.

The Peruvian Cashinahua represent the culturally more conservative part of this ethnic group whose ancestors migrated to Peru around a century ago fleeing conflict along the Envira River (Brazil), where they worked on rubber plantations (Johnston et al. 1969). Following a revolt in Brazil against the rubber bosses, the Peruvian and Brazilian Cashinahua were divided at the beginning of the 20th century (McCallum 1999; Montag 1998). One group moved to the headwaters of the Curanja River in Peru, where they remained isolated, far from the rivers used by rubber traders, until 1946. Over the course of more than a century in which the two groups were separated, significant differences in the patterns of their lifestyles emerged. Even though a definitive connection to Peruvian society has now transpired, the Cashinahua nonetheless profit from their geographic isolation and thus live, in comparison to other groups, relatively unaffected by massive foreign influences (Keifenheim 1999). There are presently approximately 1,830 individuals of the Cashinahua community inhabiting Peru (INEI 2018). This accounts for 0.4% of the registered Indigenous population in the country (INDEPA 2008). These latter descendants of the isolated group are still competent speakers of their language, which they use daily, although bilingualism with the national language, Spanish, is growing (Camargo and Reiter 2011).

The social organisation of the Cashinahua is quite peculiar and contrasts with that of the other Pano Indians of the same region. They practice a very strong form of local endogamy, in which 95% of marriages take place within the village (Deshayes and Keifenheim 2015). Additional information on Cashinahua social organisation can be found in Kensinger (1995) and Keifenheim (2015). All Cashinahua are members of one of two groups - halves, *inu bakebu* and *dua bakebu*, each of which is subdivided by sex. Cashinahua society exhibits a dualistic structure, comprising two social moieties that complement each other: the *dua bakebu* (descendants of the *dua*, or puma), and the *inu bakebu* (descendants of the *inu*, or spotted jaguar). An ideal village consists of both *inu* and *dua* families, whereby social cohesion is based upon two brothers-in-law *inu* and *dua*, preferably cross-cousins, marrying each other's sisters. Women belonging to the *inu* moiety, or *inani*, are expected to marry *dua* men, while the *banu*, or women of the *dua* moiety, are expected to take *inu* men as husbands. These partnerships serve as the foundation for social stability (Reiter and Camargo 2022). A man is a member of his father's group, and a woman is a member of her father's mother's sister's group. The halves are the structural social entities that unite all the autonomous local villages into a single society. They provide each Cashinahua with an immediate social identity in all other communities, limit marriage options, and operate as social groups for ritual and ceremonial occasions (Kensinger 1995). The basic economic and property-holding unit is the nuclear or polygynous family, and the basic social and political unit is the village. Each village is independent, with its own chief. Infrequent and irregular interactions between the villages, generally, are of a social or ceremonial nature.

Until the rubber industry reached this distant region of the rainforest, the Cashinahua were a self-sufficient group living in isolation at the headwaters of the Curanja, Envira, and Jurua rivers on the border between Peru and Brazil (Graham 2001). These Indigenous people continue to maintain a strong connection with the forest and rely predominantly on its resources for sustenance and medicinal purposes. Most plant specialists in the area gather their plants from the nearby forest, with emergency supply plants being planted in forest gardens near the community or grown along forest trails. The subsistence livelihood of Cashinahua families living along the Curanja River largely relies on hunting and the collection of non-timber forest products. Through intimate contact with and reliance on local biodiversity, these Indigenous people have developed a comprehensive understanding of the physical and chemical characteristics of the flora in the adjacent forest, as well as the skills to categorise and utilise this exceptionally diverse resource (Graham 2001). However, those who still know and use plants to heal themselves and others are slowly disappearing and usually have no successors. Access to Western medicines and the arrival of Christian missionaries (Catholic and Protestant) starting in the 1950s (Kensinger 1998) have contributed to the rejection of socio-cultural knowledge on the use of some traditionally utilised plants. In a previous study, Graham (2001) reported that within a few generations the society of this Indigenous group has transformed from being almost entirely self-sufficient and isolated to increasingly dependent on the outside world for highly prized and essential goods, including medicines. Now in both countries, the Cashinahua are increasingly giving up their autonomy and migrating to the cities, where they try to assimilate into Peruvian or Brazilian society and where their children are exposed to monolingual national education systems (Camargo and Reiter 2011). Medical pluralism and the apparent ambivalence among younger generations regarding the value of their ancestral traditions endanger the survival of Indigenous knowledge on the use of medicinal plants (Graham 2001).

2.8. Cashinahua livelihoods

2.8.1. Hunting and fishing

The subsistence of the Cashinahua community relies equally on hunting and gardening. These activities offer variety and increase the food supply, particularly when previous gardens are exhausted and new ones are not yet in production (Kensinger 1995). Game and fish from nearby forests and rivers provide additional food sources. Cashinahua men take great pride in their hunting ability, which is a crucial aspect of their masculine identity. The Cashinahua place high value on meat as the most essential food source, and it is the responsibility of each man to provide for his own family, as well as his wife's family, through the game he hunts. The Cashinahua hunt for subsistence purposes, and certain surpluses are shared among family members and traded within the same community. The most commonly used hunting weapon is the shotgun, although some traditional weapons, such as the bow and arrow, are still used (SERNANP 2013). The frequency of fishing varies from once to twice a week. The fishing gear used are nets, hooks, arrows, and toxic plants (SERNANP 2013) such as huaca *Clibadium surinamense* L., catahua *Hura crepitans* L., and barbasco *Lonchocarpus heptaphyllus* (Poir.) DC. In this sense, the Cashinahua mainly have a subsistence economy with a small part of the production reserved for commercialisation purposes.

2.8.2. Cashinahua agriculture

The Cashinahua people survive through a combination of subsistence activities such as hunting, fishing, and tending small garden plots. Although the Cashinahua are primarily hunters, they rely on small-scale migratory slash-and-burn agriculture that coincides with the seasons of the rainforest. They practice four main cropping systems: slash and burn, or swidden, agriculture that involves short-cycle crops, such as corn (*Zea mays* L.), cassava (*Manihot esculenta* Crantz), yam (*Dioscorea trifida* L.f.), and pumpkin (*Cucurbita maxima* Duchesne), which are cropped in regrown areas or virgin forests; beach agriculture, a distinctive activity among the Cashinahua community, with plantations of peanuts (*Arachis hypogaea* L.) and watermelons (*Citrullus lanatus* (Thunb.) Matsum. & Nakai); banana (*Musa* spp.) plantations by the river, where clay soils are predominant; and small gardens around their houses, mainly composed of aromatic and medicinal species.

While male economic activity is primarily attributed to hunting, gardening still accounts for a significant portion of their time throughout the year, and certain months require their utmost attention. The majority of the Cashinahua diet is sourced from these gardens, and neglecting to clear and plant crops adequately has a negative impact on their ability to provide for their family. This failure, particularly in the early stages of marriage, can put a great deal of strain on the already fragile marital bond) (Kensinger 1995). Every year, the responsibility of swidden clearing and planting lies with men, with women in charge of garden management once planting is complete. Men generally oversee planting, whilst women harvest the crop. Peanuts are an exception to this, as they are always planted collaboratively by both men and women. Similarly, women are responsible for planting crops such as cotton, annatto, and beans, contrary to the usual gender division of labour. In Cashinahua gardens along the Curanja River, roughly 30 species of cultivated plants were recorded. The largest group consisted of food plants, with various folk varieties for each; cultivated fish poisons, cotton, tobacco, and arrow cane followed in number (Graham 2001).

The Cashinahua people identify four types of gardens: *bai kuin* or *manan bai*, which is the permanent garden; *hene kexa bai*, the river bank garden; *tama bai* or *mashi bai*, the peanut or sandbar garden; and *hunu bai*, a temporary or hidden garden (personal communication). The majority of food production comes from the *bai kuin* garden. *Bai kuin*, also known as *manan bai* or "high garden," is a significant source of garden products and frequently boasts an impressive size. Usually located in flat areas near communities, the garden yields produce in one to two years, and while cassava cannot be grown after two years, bananas remain viable for a long time. Every two years, a new *bai kuin* garden is cleared. Men typically prepare the clearing and sow most of the seeds, while women focus on cultivation and harvesting. New gardens are prepared every year between June and October. Sites are chosen along the steep ridges of hills, within half an hour's walk of the village. The flat valley floor is preferred as it has less vegetation density and is easier to clear (personal communication).

The Cashinahua people ritualise the swidden clearing and planting of crops. Before planting, the terrain is slashed and burnt, both activities being undertaken by a group of men. The swidden clearance is a direct confrontation with the *yuxin* – spirit of the forest, explaining why the process is accompanied by war cries and the men paint themselves with annatto (red is the colour of the forest *yuxin*). While the men set fire to the swidden and yell, with their faces painted red, about one hundred metres away the women sing to the *yuxin* for the latter to give them a strong fire and an abundance of crops. Afterwards a collective meal is offered with abundant food (Lagrou 1991).

Once the field is cleared, planting commences with the initial sowing of cassava (*atsa*). Following this, the next stage is the planting of plantains and bananas (*mani*), and sachapapa (*pua*), which is sown around the perimeter of 10-metre diameter circular pits. Maize is then planted within these circles, colloquially referred to as 'nests', to facilitate mutual support between the plants. Finally, in August or September, corn (*xeke*) is sown as the last crop in the *bai kuin* garden. One to two rows of sugar cane (*tsisume*) *Saccharum officinarum* L. are planted along the edges to demarcate the garden. Sweet potato (*kadi*) *Ipomea* Spp. is planted in the centre of *bai kuin* without the use of support sticks and its sprawling growth covers the soil and helps prevent weed growth. The Cashinahua also cultivate other food plants in the *bai kuin* garden, such as *Xanthosoma* spp. (*yubin*), *D. trifida* (*niya yuxu*), *Carica papaya* L. (*badan*), and *C. maxima* (*nixi badan*). Indigenous tubers used for food are typically not cultivated but rather collected freely from nearby forests; among these are *Calathea allouia* (Aubl.) Lindl., *Pachyrhizus tuberosus* (Lam.) Spreng., *Canna edulis* Ker., and palm heart (various Araceae species) when available. In the *bai kuin* garden, commonly cultivated condiments include ginger (*xiada*) *Zingiber officinale* Roscoe, pepper (*yutxi*) *Capsicum chinense* Jacq., and annatto (*maxe*) *Bixa orellana* L. Non-edible plants cultivated in the *bai kuin* garden include *Lonchocarpus* spp. (known locally as barbasco or *sika*) and *Clibadium sylvestre* (Aubl.) Baill. (known as huaca or *pui kama*), which are used as fish poisons within the community. The garden also features various types of cotton and tobacco (*dume*).

Hene kexa bai is a riverside garden which yields crops for a short period of eight to nine months. Following the growing season, the area is prone to flooding. However, the same land can be cultivated annually as long as the ravine remains intact and regularly fertilised with alluvial water. This garden is used by women to cultivate a variety of legumes, after which cassava (*atsa*) is sown. It is considered appropriate to sow corn (in May or June) when the first leaves of cassava sprout. The Cashinahua people sow pumpkin (*nixi bada*) in addition to corn. *Tama bai*/*mashi bai* patches, also known as peanut patches, are planted on sandbars along the Curanja River or its tributaries. *Tama bai* gardens are cleared of vegetation cover as soon as the floods recede at the end of the rainy season, typically in May or June. Watermelon and squash are planted along the patch edges. Cassava or maize is planted intermittently at the edges and back of gardens, or as a boundary between the gardens of different families. *Hunu bai*, which are small garden plots cleared from virgin forests or along rivers, are used to supplement *bai kuin*. *Hunu bai* can be created during any time of the year, but they are typically made in the rainy season, when trees and brush do not burn well, making them hidden (*hunu*), in contrast to *bai kuin*, which are openly visible (*xaba*). A clearing is usually created by a lone man. In the *hunu bai* people solely cultivate maize, occasionally supplemented by cassava. After the harvest, the fields are permitted to revert to forest without any weeding (this section is based on personal communication with community members from the studied villages).

As agriculturalists, the settlement patterns of the Cashinahua were traditionally semi-permanent. Villages were typically occupied for four to six years after which new gardens were prepared in another area. By the time the gardens in the new village began to produce, the Cashinahua had fully occupied the new site. This resulted in the Cashinahua moving between the Murú, Tarahuacá, Envira, and Curanja rivers, across what are now the borders of Peru and Brazil (Graham 2001; Kensinger 1995). With the granting of land titles to most Cashinahua villages along the Curanja River and the establishment of schools by the government within these communities, this traditional movement is now confined solely to these titled areas. Until recently, the Cashinahua relied almost exclusively on locally sourced materials for their daily needs. Recent introductions of foreign goods and techniques have caused only minor modifications to the traditional subsistence patterns (Kensinger 1998).

2.8.3. Cashinahua beliefs and the concept of *yuxin*

The quest for understanding the universe and its inhabitants is universal to all human societies. Indigenous Amazonian cosmologies stem from the concept of multiple and permeable spheres of reality, without imposing limits between nature and society, humans and animals, and the sacred and the profane, which contrasts with typical Western traditions (Keifenheim 1999). Kensinger (1998) states that one of the ancestral beliefs with which the Cashinahua explain the world refers to the existence of two fundamental aspects: the visible or material side and the invisible side. The visible world is the domain of human beings and all other living things, while the invisible world is the domain of spirits (*yuxin*) that are impossible to see except in dreams and through hallucinogenic experiences. In Cashinahua cosmology, there exist distinct worlds and spheres within each one. Their animistic perspective of the universe posits that every material thing or subject has a spiritual equivalent called *yuxin* (Graham 2001; Kensinger 1995; Langdon and Garnelo 2017). Indigenous people must organize their lives with the guardian beings of nature according to specific rules, and their survival is based on dynamic communication and a harmonious balance between the inhabitants of different realms. The concept is closely linked to Cashinahua traditions and beliefs regarding health, illness, and disease. These beliefs and practices cannot be separated from the parallel spirit world, which closely overlays the visible, physical world (Graham 2001). Most rural cultures do not hold the view that disease and death have an organic or physical cause, rather the spirit world is the source of both. The use of medicinal plants in the study area is highly ritualised, i.e., associated with various kinds of beliefs or with magical or religious practices, as is likely the case in all rural cultures (Bussmann et al. 2010; Graham 2001; Jauregui et al. 2011). One crucial element of Indigenous ethnobotanical practices is the concept that plants serve numerous functions simultaneously, including medical, social, cultural, pharmacodynamic, and symbolic roles. These roles fluctuate significantly over space and time and experience frequent interrelations. Ethnobotanical interactions in all their aspects reveal significant information about wider ecological and social processes (Alexiades 1999).

How the Cashinahua view the body as an entity that is continually created out of the environment by external agents is illustrated in McCallum's (1996) article. The Cashinahua body is not considered to grow naturally; it is brought into existence and 'made to grow' through external intervention, as an individual entity that is constituted - in indigenous terms, 'grown' - through knowledge. Knowledge is transmitted through controlled contact with various aspects of the environment, including material, verbal, and occasionally spiritual forms. It is passed down from person to person and is therefore socially embedded with connotations of gender, kinship, and morality. McCallum's text describes the acquisition and integration of knowledge into the body and its organs in Cashinahua epistemology. The concept of embodied knowledge is based on the relationship between a person's spirit, particularly the 'spirit of the body' (*yuda yuxin*), and their physical, mental, and emotional faculties. The body is the site of convergence of social and supernatural processes, and it is shaped by others through various means such as diet, abstinence, medicine, body painting, baptismal rituals and formal education. The Cashinahua perceive this process as fundamental to their kinship and relationships. They refer to it as 'making grow' (*yume wu-*), which involves the use of specific plant 'medicines' (*dau*) to cure and treat the body. The Cashinahua believe that knowledge and the body are so closely intertwined that any disruption to one can have significant consequences for the other. Insight into the interdependency between knowledge and the body in Cashinahua thought and practice will deepen our understanding of how these people view illness and curing. It is only when the relationship between knowledge and the body is clear, according to McCallum (1996), that these 'medical' issues become accessible in this ethnographic context.

The Cashinahua believe that a person is made up of a body and five spirits. The most powerful spirits are the Eye Spirit (*bedu yuxin*) and the Shadow Spirit (*yum baka yuxin*), both of which play an important role in the realm of perception and knowledge, the former being closely associated with spirituality and supernatural realities, and the latter with all kinds of physical knowledge and experience. Both spirits survive after physical death and are able to interfere in the affairs of the living (Keifenheim 1999). Informal interviews with healers and their patients revealed a widespread belief in the spiritual and magical origin of diseases. According to different authors (Graham 2001; Bussmann et al. 2010; Alexiades 1999; Luziatelli et al. 2010; Jauregui et al. 2011), the majority of native Amazonian people believe that ancestral wrath, sorcery, or an attack by a spirit are the causes of sickness and misfortune. According to Sobiecki (2014), they frequently point to strained social relationships. Because specific ailments are perceived only as the result of acts of spiritual agents, the herbalists in our study insisted that we include plants that can be considered “magic” without regard to their status.

The quest for knowledge of these elusive dimensions is at the heart of the religious experience of Amazonian Indigenous peoples, both at a personal and a communal level. This experience is accessed through dreaming, the ingestion of psychotropic or psychedelic substances, or through a series of practices involving prolonged fasting that have a similar result. In the case of the Cashinahua, it is most commonly achieved through the ingestion of *nixi pae*, also known as *ayahuasca*, or by inhaling a snuff made from local tobacco *dume* powder mixed with the ashes of *Cecropia* sp. leaves, which is believed to separate the spirit from the body (Lagrou 1991).

The Cashinahua interact with spirits consistently, either consciously or unconsciously, when they associate with nature and with each other (Kensinger 1995). In their ceremonies and through the ingestion of *nixi pae*, the sacred spiritual brew, the Cashinahua people provide a ritual framework for their correspondence with the universe of *yuxin*. The Cashinahua drink *ayahuasca* to find out about things, people, and events removed from them in time or potentially space, which could influence either society as a whole or its individual members. It is also occasionally utilised to obtain information about the reason for a disease that has not reacted to *huni dauya* medicines. The Cashinahua engage in a collective practice of consuming ayahuasca, which is regarded as the preserve of shamans in many native Amazonian groups (Lagrou 1991). *Nixi pae* can be consumed by any initiated male, but it is never consumed by a single individual alone.

2.8.4. *Katxa Nawaa* fertility celebration and *Nixpu Pimaa* initiation ritual

In the 1960s, missionaries established the first Cashinahua schools in the Purus region of Peru, as well as created bilingual educational resources as a by-product of the ongoing New Testament translation work. By the 1980s, the Cashinahua group's essential rituals, which traditionally conveyed their socio-cultural history to future generations and fostered social cohesion (*Txidin* and *Nixpu Pimaa*, initiation ritual), had been abandoned. Currently, the *Nixpu Pimaa* ritual has been transformed from a communal celebration to a mostly private event. The *Katxa Nawaa* ritual, also known as Mariri, is the sole surviving ceremony amidst the cultural influences from external sources. Celebrated by the Cashinahua community, it represents a perpetually renewed alliance between allies and highlights the group's unique connection with nature, specifically focused on the concept of fertility. The biocentric perspective is exemplified by the interdependence of human fertility and that of plants, as evidenced in the ritual of *Katxa Nawaa*. Additionally, the presence of *yuxins*, supernatural forest beings that require respect and invocation through ritual, serves as another manifestation (Reiter and Camargo 2022).

In numerous Amerindian cosmologies, teeth are viewed as the source of vitality. As such, teeth blackening has long been an essential part of the ritual and ceremonial make-up of all adult Cashinahua men and women, along with body painting and hair styling (for men). The ritual of blackening the emerging adult teeth of boys and girls who have already shed their milk, or deciduous, teeth is the central event in the rite of passage called *Nixpu Pimaa*, which translates as "making (them) eat *nixpu*" (the teeth-blackening sprouts of some species of *Piper*). It is a custom of valuing a child's name, and the process involves herbal bathing. The first tooth blackening is still regarded as a significant passage from childhood into adolescence (Lagrou 1996). Applying blackening sap from *nixpu* plants to the teeth is also still considered important to prevent tooth decay.

2.8.5. Cashinahua concepts of health and disease

The WHO and the PAHO have acknowledged that health is impacted by cosmovision, a collection of elements that shape how various cultures perceive reality, acquire knowledge, and understand their position in the world. This set forms the foundation for various beliefs, values, practices, communication methods, and behaviours. Furthermore, it shapes individuals' relationships with other individuals, society, nature, and spiritual entities. Likewise, it also influences the interpretation of illness, individual and group experiences, and chosen therapeutic practices (WHO 2007). It is suggested that the intercultural approach to health and illness for Indigenous peoples requires an openness towards their worldviews. Health is primarily influenced by the balance between individuals and groups, according to certain values and behavioural norms, and therefore the framework of Indigenous perspectives can aid in comprehending their unique experiences of health and illness. From this viewpoint, the PAHO and the WHO acknowledge that the health concepts of most Indigenous peoples are all-encompassing, signifying ever-changing relationships shared by individuals (physical, mental, spiritual, and emotional) and communities (political, economic, cultural, and social), and that the natural and social elements are interconnected and indivisible. It is suggested that analysing the health status of Indigenous peoples demands comprehension of the significance of the health-disease complex in these populations, considering several alternative viewpoints (Bhaumik et al. 2018). In most cases, this analysis goes beyond the biomedical field into a broader arena that primarily involves the social, economic, political, and historical sciences.

It is recognised that the traditional medical systems employed by Indigenous communities are not inflexible or impenetrable. In the case of the people of Purus, their theories and methods have been advanced by the concepts provided by other Indigenous groups within the region pertaining to aetiology, specialists, and treatments. Furthermore, the health services provided by both missionaries and state health services have played a role in this progression. Numerous epidemics in the past seventy years have significantly impacted these populations and weakened Indigenous traditional medical systems. Factors involved in this trend include the disappearance of specialists, lack of confidence in their own resources, and evangelisation challenging the foundations of indigenous theories of disease (Ministerio de Salud del Perú 2019). Health and illness are culturally mediated experiences perpetuated through a system of symbols that establishes a structure for framing and comprehending these phenomena. Indigenous people do not view health and illness as purely biological or physiological entities; rather, they represent primarily socio-cultural processes and secondarily, physiological processes, as their interpretation occurs within a cultural and social context (Langdon and Garnelo 2017). The frustrations and conflicts experienced by medical personnel working in Indigenous areas, such as Purus Province, are likely caused by a lack of proper understanding of this phenomenon (Ministerio de Salud del Perú 2019).

2.8.6. Cashinahua medicine and medicine men

The following overview of the Cashinahua medical system (Kensinger 1974) presents an objective account of the period from 1955 to 1968, during which Kenneth Kensinger lived and collaborated with the Cashinahua of the Curanja River. The review is intended to aid our understanding of the status of medicinal plant use in this ethnic group.

The term *pei* denotes a leaf in the *Hantxa Kuin* language, while *dau* refers to medicine in general or 'plants with power', which can be medicinal, toxic, or psychoactive. Western medicines introduced by traders and missionaries as well as Cashinahua traditional ornaments, or *kene*, worn for rituals and festive occasions are also included in the *dau* category. *Pei dau*, or leaf medicine, includes most plants used by Cashinahua herbalists, and thus this term is employed to refer to their traditional herbal medicine. The Cashinahua divide medicines into two main categories: *dau bata*, which means 'sweet medicine', and *dau muka*, which means 'bitter medicine'. *Dau bata* is associated with the title *huni dauya* 'man of sweet medicine', which means 'herbalist' (Kensinger 1995). The term *dauya* is also used to designate a poisoner and, in contemporary usage, a biomedical doctor (Kensinger 1974) who is qualified to treat illnesses that are considered natural. The *huni dauya* herbalist rarely treats the patient personally. Rather, on request, he will gather the appropriate herbs in the wilderness and present them to the person making the request, along with instructions on how to use them. The patient then follows the instructions for treatment. In most cases, the specialisation of a *huni mukaya* (shaman) does not overlap with that of a *huni dauya*, an herbalist. The learning experience differs greatly between the two vocations. To learn *huni dauya*, one must undertake an apprenticeship with another plant specialist, and requires a good memory, keen perception, and a desire to serve. The shaman's method of learning varies greatly from that of the herbalist. The *huni mukaya* is known as the 'man with the bitter medicine', and he is a shaman, diviner, sorcerer, and prophet. *Muka dau* is an undefined deep quality that the *huni mukaya* is moved by, which is received from spirits in the most common way of transforming into a trained professional. The *huni mukaya* negotiates between the human and non-human worlds (Kensinger

1995). He gains knowledge by communicating with his spirit relatives - beings who live in non-human worlds. *Huni mukaya* as a shaman is called upon when the treatment of *huni dauya* does not result in a cure and is therefore thought to be caused by spirits.

This was the reality of the Cashinahua people until they encountered the outside world. During the post-contact measles epidemics, the last *huni mukaya* died, which is why *muka* healing is no longer practiced today. The medicine of the *huni dauya* continues to provide cures for many ailments, although this system of medicine has also been affected by increased contact with the outside world (Graham 2001; Kensinger 1995). Plants used to alter personal physical aroma, plants used to control or change human behaviours or perceptions, and 'plants with power' (such as toxic and psychotropic plants or plants that provide protection) are all included in the *dau* category. It is similar to the Shipibo (another Panoan group prevailing in Ucayali region) perception of *rao* (Tournon 2006).

There are two possible types of illnesses that are thought to be natural in origin: those that the patient "has", *haya*, such as fungi, sores, swellings, dysentery, and boils; and those that the patient "feels", *tenei*, or "is", such as pain, nausea, laziness, sleeplessness, failure in hunting, anger, selfishness, and feelings of personal inadequacy (Kensinger 1974).

The Cashinahua consider each symptom to be a separate disease and give it its own name. The name describes the appearance of the disease, the physical sensation it causes, its location, or its natural cause. For each disease (symptom) a single medicine or class of medicines is used as a treatment. Each plant has a name, which reflects the type of disease for which it is a remedy, or a specific physical or therapeutic quality of the actual species. Most plants are used for general treatment, although some are specific to a disease. According to Kensinger (1995), the Cashinahua view medicine as an essential part of their way of thinking and acting. In the botanical realm, Cashinahua herbalists are highly skilled observers; however, to identify plants, they seem to rely more on smell, taste, and tactile evaluation than on purely visual clues (Graham 2001).

3. Rationale of research

3.1. Ethnobotany

Ethnobotany is defined as “the study of direct interrelations between humans and plants” (Ford 1994). The power of ethnobiology and ethnobotany lies in their aptitude to integrate numerous viewpoints on the connections between humans and nature. Drawing on a range of interdisciplinary fields, including archaeology, geography, plant/animal systematics, population biology, ecology, mathematical biology, cultural anthropology, sociology, ethnography, pharmacology, nutrition, conservation, and sustainable development, the disciplines of ethnobiology and ethnobotany offer a comprehensive approach to understanding the complex and dynamic interactions between humans and the natural world. This interdisciplinary approach not only enhances our intellectual comprehension, but also has extensive implications for practical applications linked to conservation and sustainability (ISE 2006). The strong links between biological and cultural diversity within ethnobotany make it an effective approach for addressing various global challenges facing the world's population. These concerns consist of topics such as sustenance security, biodiversity preservation, temperature change minimisation, and human health (Gaoue et al. 2017).

3.1.1. Current trends in ethnobotanical research

Because ethnobiology and ethnobotany are concerned with the dynamic interactions between humans and the natural world, these fields of study are constantly evolving and expanding, becoming increasingly complex, multifaceted, and diverse (Alexiades 2003). Ethnobotany is a rapidly growing science, attracting researchers from a wide range of academic backgrounds and interests. It is still predominantly associated with economic botany, and is therefore used to determine the potential economic value of various plants (Idu 2009). From a scientific point of view, research has moved from simple inventories, for example mainly medicinal plants, to detailed quantitative studies, often focusing on all useful plants. Measuring the significance of plants and vegetation to individuals or communities is a core aspect of quantitative ethnobotany. An index is a prevalent approach to quantifying otherwise qualitative data in the biological and social sciences (Hoffman and Gallaher 2007). Ethnobotanists utilize Relative Cultural Importance (RCI) indices, like the "use values" established by Prance et al. (1987) and (Phillips and Gentry 1993), to calculate a value per folk or biological plant taxon. These methods can yield information that is suitable for testing hypotheses, statistical validation, and comparative analysis (Hoffman and Gallaher 2007).

In recent decades, the focus of ethnobotanical studies and the involvement of local stakeholders have changed considerably. More importantly, however, research has finally moved away from colonial-style research to modern ethnobotany based on the principles of the Nagoya Protocol. This is of great significance to the ethnobiological community. However, these changes have not been the same in all Latin American countries, and there are great regional differences (Bussmann and Sharon 2015). The 1992 Convention on Biological Diversity (CBD) mandates commercial users of traditional knowledge to share profits with holders and their communities in an equitable manner (Dutfield 2010).

3.1.2. Indigenous knowledge systems research

Indigenous knowledge systems and biological expertise passed down through generations have significantly contributed to the study of Amazonian biodiversity. The transfer of this traditional knowledge to tropical biologists is reliant on the holders' capability to translate it in a way that allows for its inclusion in their experimental framework. This poses a fundamental challenge for ethnobiology: to recognise the interdisciplinary nature of the subject and identify successful approaches for integrating, evaluating, and coherently synthesising different perspectives (Graham 2003). The use of scientific knowledge about biological resources for human well-being requires data on socio-economic aspects, environmental impacts, or biodiversity conservation. Mixed methods research, combining both quantitative and qualitative methods, is a growing trend in the social and human sciences worldwide. It is a research approach that is favored in the social, behavioural, and health sciences where researchers gather, analyse, and integrate both quantitative and qualitative data in a single study or a long-term program of inquiry to address their research questions. Using a combination of quantitative and qualitative data aids the researcher in comprehensively understanding research questions (Creswell 2013). A contemporary scientific approach to examining ethnobotany involves precision of facts, statistical validation of information, and numerical or semi-numerical scrutiny of field observations. These factors indicate the necessity of interdisciplinary collaboration among researchers.

When comparing articles on interdisciplinary collaboration between the natural and social sciences published between 1990 and 2014, Barthel and Seidl (2017) discovered that the proportion of interdisciplinary articles is overall low, with only a slight uptick in the last decade. In collaborations between natural and social sciences, economists typically represent the social sciences. Additionally, Barthel and Seidl (2017) found that periodicals containing interdisciplinary research had lower impact factors than mono-disciplinary counterparts, with interdisciplinary articles receiving fewer citations.

3.1.2. Emic versus etic perspectives in the context of this thesis

The emic/etic distinction was created in linguistics during the 1950s as a way to identify two complementary viewpoints for studying human language and behaviour. This idea was imported into anthropology, where etic was used to represent the ambition to establish an objective and scientific approach to cultural studies, while emic aimed to understand the world from the perspective of one's interlocutors. Emic and etic have since been appropriated as concepts by various other disciplines and subfields within the humanities and social sciences (Mostowlansky and Rota 2020). Emic and etic are terms used in the fields of anthropology, linguistics, and related social sciences to describe different approaches to studying and understanding cultural phenomena, behaviours, and language (Feleppa 1986). In summary, the emic perspective focuses on understanding a culture or phenomenon from the inside, respecting its internal meanings and context, while the etic perspective emphasises an external, comparative analysis that can be applied across different cultures. Both perspectives have their advantages, and researchers frequently employ a combination of emic and etic approaches to gain a more comprehensive understanding of cultural phenomena. The present dissertation adopts a comparable approach.

3.2. Ethnopharmacology

Ethnopharmacology is the scientific investigation of materials, encompassing various plants, utilised by distinct ethnic and cultural groups for medicinal purposes. It can be deemed synonymous with the inquiry of traditional medicines (McGonigle 2017). As a specifically designated field of research, ethnopharmacology has a relatively short history. The term was first used as the title of a book on hallucinogens in 1967. This book examines the pharmacological properties of plants, fungi, and other organisms used locally or traditionally as medicine or to improve health. One distinct characteristic of this field is its consideration of the traditional and anthropological context of the drug's origin. Within ethnopharmacological research, specific plant species have been, and in some cases still are, substantial reservoirs of novel molecules for the development of new allopathic drug (Houghton 2002; Katiyar et al. 2012).

3.3. Medicinal plant use and the erosion of medicinal plant knowledge

The use of plants for various ethnobotanical purposes is a common tradition in rural communities in developing countries, particularly for human healthcare. Traditional medicine is widely used around the world and holds increasing economic significance. It is frequently deemed the only accessible and reasonably priced form of treatment available in developing countries (Bussmann and Sharon 2015). As peoples' reliance on rainforests, which was previously a crucial means of subsistence for native communities, diminishes and fresh prospects captivate young people, the necessity for a more profound comprehension of the forest and its ecological principles is gradually vanishing. Additionally, the loss of practical awareness and enthusiasm for traditional ways of life among younger generations is leading to a decline in the use of Indigenous languages to identify flora, fauna, insects, and natural phenomena. The collection of medicinal plants, hunting, fishing, and attending extensive community ceremonies are diminishing in significance (Kensinger 1995). This broad spectrum of Amazonian culture, developed over centuries through the understanding, use, and protection of the rainforest, is changing irrevocably. Knowledge and practices passed down from generation to generation are disappearing along with the forest. Few people have gained as comprehensive an understanding of the physical and chemical properties of their plant environment as the Indigenous groups of South America. It is unfortunate that with the gradual disappearance of the tropical rainforest, many Indigenous cultures and their respective knowledge are being lost at a rate that may exceed scientific capacity to document and record important ancestral traditions, knowledge, and interrelations with the natural world, including medicinal plants (Graham 2001). Therefore, there is an urgent need for research and the documentation of medicinal plants and their traditional use in human healthcare in under-researched areas.

3.4. Peruvian medicinal plants

Peru boasts a rich biodiversity and millennia of traditional healing practices. The country's flora has long been employed by traditional practitioners to cure ailments, and many of the same plants are still used today. Traditional medicine remains popular in Peru due to the limited access to Western medicine and its resources available to large numbers of the population (Bussmann and Sharon 2010). Medicinal plants represent a significant element of Peruvian traditional medicine, which reflects pre-Columbian cultures. The pottery of numerous Pre-Inca and Inca civilizations portrayed the use of plants to treat physical and spiritual illnesses, as illustrated by colonial chronicles. To this day, plants remain the foremost choice for medical consultation and treatment in Peru (Lock et al. 2016).

Reports on the number of medicinal species in Peru vary from the nearly 3,000 species mentioned by Mostacero et al. (Mostacero et al. 2011) to the 1,100 species described by Agapito and Sung (2004). Antonio Brack Egg (1999), after a comprehensive collection of available information, ascertained that almost 5,000 plants are exploited in Peru for 49 unique purposes, including the therapeutic applications of some 1,400 species.

A special contribution from traditional Peruvian medicine to world pharmacotherapy is the alkaloid quinine. Originally, Indigenous people in Peru used cinchona (*Cinchona officinalis* L.) bark extract to reduce fever. Quinine, an alkaloid found in the bark of the cinchona tree, became an essential antimalarial drug that has made an exceptionally significant contribution to world pharmacotherapy (Rengifo 2000). Additionally, the balsam of Peru (*Myroxylon balsamum*) has played a pivotal role in wound treatment on a global scale (Lock et al. 2016).

According Lock et al. (2016) the most researched Peruvian medicinal plants are *Smallanthus sonchifolius* (Poepp.) H.Rob. (yacon), *Croton lechleri* Müll.Arg. (sangre de drago - dragon's blood), and *Uncaria tomentosa* (Willd. ex Schult.) DC./*U. guianensis* (Aubl.) J.F.Gmel, known as cat's claw in English, *vilcacora* in Quechua, and *uña de gato* in Spanish.

Smallanthus sonchifolius, known as yacon, is a medicinal plant from the Asteraceae family, naturally found in Ecuador, Colombia, and Peru, that has been used in traditional folk medicine for its outstanding nutritional and therapeutic benefits since pre-Hispanic times (Egg 1999). The roots are utilised to rehydrate the body due to its high-water content, as well as prevent fatigue, cramps, rickets, and liver conditions. In the north of Peru, it is traditionally consumed before going to bed to delay aging. Moreover, yacon roots have been suggested to have potential health benefits such as alleviating constipation, reducing high blood pressure, and preventing colon cancer. The roots are also believed to possess antimicrobial and antiparasitic properties attributable to their oligosaccharide content. It is important to note that oligosaccharides are the main constituent of yacon roots, making up an estimated 50-70% of the dried root biomass (Lock et al. 2016). Recently, there has been renewed interest in yacon owing to its numerous health benefits to humans. The roots and leaves of *S. sonchifolius* have been used to alleviate symptoms of diabetes, digestive issues, and renal disorders. A chemical analysis of the aqueous yacon leaf extract has identified the presence of the sesquiterpene lactone enhydrin and the dimer enhydrofolin as the primary compounds, as well as phenolic compounds (Moreira Szokalo et al. 2022). Additionally, these leaves exhibit potent antioxidant activity (Yuan et al. 2022). The leaves are also edible and contain high levels of protein (ranging from 11-17% in dry form). Yacon tuber roots are highly esteemed as a food and sugar alternative, with significant potential in the pharmacology industry to produce inulin, a fructose polymer, as yacon contains the highest percentage of inulin (up to 20%) of any plant in its roots. Inulin and fructose are well-suited for individuals with diabetes. Yacon leaves are also medicinally valued, as a warm compress, to alleviate rheumatic and muscular pain (Egg 1999).

From the genus *Croton*, family Euphorbiaceae, the most widely utilised plant in traditional Amazonian medicine is *Croton lechleri*. This tree contains a red latex that has been utilised for ages by Indigenous people to treat wounds, fractures, postpartum bleeding, and stomach and intestinal ulcers, as well as to alleviate rheumatic swelling. It is also used to treat leucorrhoea, gonorrhoea, malaria, and tumours, as a vaginal antiseptic, and for its contraceptive properties (Egg 1999; Rengifo 2000). The sap of dragon's blood serves in folk medicine as a cicatrising, anti-inflammatory, and anti-cancer agent. Research has confirmed its mutagenic and antioxidant activities (Lopes e Lopes et al. 2004). The latex of *C. lechleri* is abundant in the alkaloid taspine, possessing medicinal properties, as well as oligomeric proanthocyanidins (SP-303), which exhibit a vast spectrum of activity against different respiratory syncytial viruses (RSV). It is worth mentioning that thirty alkaloids have been isolated from the genus *Croton*, including pyridone, indole aportine, quinoline, sinoacutine, sparciflorine, along with benzoic acid, pigments, tannins, and other compounds (Egg 1999). *C. lechleri* displays immunomodulatory activity and exhibits inhibitory activity on both CP and AP of the complement system. It should be noted that taspine cannot be solely responsible for these activities, and other constituents, probably including proanthocyanidins, may play a role (Risco et al. 2003).

Uncaria tomentosa and *U. guianensis* are vines highly valued for their medicinal properties by native and mestizo communities in the Amazon. Additionally, they are Peru's most extensively traded medicinal plants, and their export is important for the agricultural economy of Peru (Egg 1999). The stem bark contains alkaloids, glycosides, and isopentane compounds. Cat's claw alkaloids stimulate phagocytosis, have a positive action on the reticuloendothelial system, stimulate the immune system, have anti-inflammatory action, and inhibit viruses, among other benefits. The bark and root of *U. tomentosa* are widely used by the Amazonian population as an anticarcinogenic and anti-inflammatory agent, for the treatment of arthritis, venereal diseases, and snakebites, as an aphrodisiac, and its leaves are used to combat measles (Egg 1999). *Uncaria guianensis*, known by the same vernacular name, has similar uses.

Traditional medicine, an important representation of the ancestral knowledge of Amazonian peoples, utilises numerous plant species for treating ailments and other syndromes (Rengifo 2000). In the primary stages of the initiation and training of traditional medicine in Amazonian societies living in eastern and central Peru, a particular range of flora is used. These plants, known as 'plantas maestras' (master plants), help traditional medicine initiates to acquire sacred knowledge, understand traditional healing practices, and use plants for healing (Jauregui et al. 2011).

3.4.1. 'Plantas maestras': a culturally significant species from the Peruvian Amazon

The small group of plants, commonly referred to as 'plantas maestras', play an important role in the training and apprenticeship procedures of traditional Amazonian herbal medicine, as reported by various scholars (Jauregui et al. 2011; Schultes and Raffauf 1990; Tournon 2006). All these plants are considered to have medicinal and magical properties; however, they do not necessarily have to have a psychotropic or psychoactive effect. Rather, their use during the initiation process contributes to cultural continuity, establishing Indigenous medical practices within their own cosmologies and environment, and fostering social coherence among local Indigenous communities (Jauregui et al. 2011). Tobacco (*Nicotiana rustica*) and ayahuasca, a brew concocted from *Banisteriopsis caapi* and *Psychotria viridis*, are regarded as the most crucial and potent species in the cosmovision of Amazonian Indigenous peoples and are always present in medical practice (Jauregui et al. 2011). Ayahuasca or *nixi pae* in *Hantxa Kuin* is an entheogen beverage that is unmistakable in the ethnomedicine and shamanism of native Amazonian ethnic groups. It is prepared from the stalks of several lianas of the genus *Banisteriopsis* and the leaves of a shrub identified as a member of the genus *Psychotria* (*kawa*). Chemical analysis indicates that the active compounds of *Banisteriopsis* are the β-carboline alkaloids harmin and harmaline, while that of *Psychotria* is N,N-dimethyltryptamine (DMT) (Malhi et al. 2014). The unique pharmacology of the mixture depends on the oral activity of the vision inducing agent, DMT, which results from inhibition of monoamine oxidase (MAO) by β-carboline alkaloids. MAO is the enzyme that normally degrades DMT in the liver and gut (Callaway et al. 1999).

Tobacco is regarded as a powerful master plant that was originally cultivated by Indigenous societies in Central and South America over 3,000 years ago. The plant was considered sacred and utilised for medicinal purposes and spiritual communication, and it still plays a significant role today in various tribal ceremonies and rituals (Schultes and Raffauf 1990). Therefore, understanding the cultural significance of tobacco in these communities is crucial for respecting their traditions and values. The negative connotation of tobacco in contemporary society entails the risk of mistakenly considering this extraordinary medicinal plant a plague that needs to be eradicated. This stigmatisation results from modern Westerners' ignorance about the correct and ritualised use of this plant, which from time immemorial has been considered sacred throughout the Americas. Tobacco *N. rustica,* commonly known as mapacho or *dume* in *Hantxa Kuin* and *rome* in Shipibo-Conibo, is regarded as one of the oldest and most potent plants by Indigenous communities (Jauregui et al. 2011). Decoctions of the whole plant are utilised to remedy skin infections and aid in managing scabies and itchiness. A poultice of fresh leaves is an option for the treatment of headaches, whereas chewing the plant is a customary remedy for alleviating toothache (Rengifo 2000). Additionally, *ampiri*, name given to the tar produced by the final combustion of tobacco, has lethal effects on larvae when applied topically, and thus it is used to treat myiasis and even snakebites. The word ampi means both "medicine" and "poison". The primary function of the tobacco plant's use, according to many Amazonian cultures, is to cleanse patients of the negative energies accumulated throughout their lifetime, both physically and spiritually. The plant provides protection, strengthens, and instructs initiates on how to use it for various healing purposes through visions and dreams (Jauregui et al. 2011). Pharmacological studies have highlighted the potential of nicotine in the prevention of neurological diseases such as Alzheimer's and Parkinson's (Liu and Zhao 2004).

Another significant contribution to modern pharmacopoeia, and specifically to anaesthesiology, is the coca plant (*Erythroxylum coca* Lam.). Cocaine initially extracted from the plant in 1859, later led to the development of local anaesthetics like lidocaine. The coca plant holds immense cultural and historical significance in Peru and other Andean nations. The initial cultivation and utilisation of the coca leaf in the region have been traced back to 700 B.C., but recent discoveries in Ecuador suggest human usage for over 5,000 years. Indigenous communities have grown and utilised this plant for centuries as a customary plant for medicinal, ritualistic, and stimulation purposes, and it remains a crucial aspect of Peru's economy and culture. Chewing coca leaves is a widespread practice among Andean communities to alleviate the effects of altitude sickness and to provide a sense of physical endurance and overall wellness. It is well known that *Erythroxylum* plants are rich in tropane alkaloids, and the representative member cocaine shows remarkable activity in the human central nervous system (Lv et al. 2022). Among the different *Erythroxylum* species, *E. coca* has the greatest concentration of cocaine alkaloid in its leaves, ranging from 0.7-1.8% by weight (Van Dyke and Byck 1982). This alkaloid produces an anaesthetic effect on mucous membranes. Following various experimental studies on cocaine, Viennese ophthalmologist Carl Koller conducted the first operation using cocaine as a local anaesthetic on a patient with glaucoma in 1884. After Koller's discovery of cocaine's local anaesthetic properties, its use quickly spread. However, due to its administration in high concentrations, practitioners subsequently began to report alarming side effects. Several researchers are credited with having improved the safety of cocaine infiltration in medicine (Calatayud and González 2003).

3.4.2. Peruvian and Amazonian pharmacologically important species

Peru is ranked fifth globally for the number of plant species known for their medicinal properties that are utilised by the population (Egg 1999). In all tropical regions, including the Amazon, medicinal plants play an important role in the health care of rural populations. Moreover, they offer a plethora of biologically active compounds for producing new pharmaceuticals. To date, only a small fraction of the great number of medicinal plants found in the Amazon rainforest have undergone research for their chemical composition and potential medicinal properties (Egg 1999). Nevertheless, the plants that have been studied have already provided numerous important medicines. This indicates a hopeful direction for potential findings, whilst also emphasising the hazard of diminishing biodiversity due to the worldwide destruction of rainforests and the possible extinction of undocumented species (Idu 2009).

The Peruvian Amazon flora contains an extensive reserve of phytotherapeutic resources, making it one of the largest in the world. However, the potential of Peruvian natural products (NPs) remains underexploited since most of these useful native species can be domesticated or semi-domesticated (Lock et al. 2016). Moreover, the amount and nature of experimental evidence published on active natural products are still limited (Gonzales and Valerio 2006), and most of the current studies have reported crude medicinal activities, while potentially active natural products have been isolated only from a few numbers of plants (Bussmann 2013).

According to recent data published in the Peruvian Natural Products Database (PNPD) for in silico drug screening (Barazorda-Ccahuana et al. 2023), the genera with the most active compounds are *Uncaria* (10.71%), *Lepidium* (10%), *Copaifera* (5.71%), *Coffea* (5.36%), *Plukenetia* (5%), *Croton*, *Minthostachys*, *Smallanthus*, and *Solanum* (all 4.64%), *Abuta* (3.93%), and *Eqisetum*, *Mansoa*, and *Schinus* (all 3.57%) (Newman and Cragg 2020).

Maca (*Lepidium meyenii* Walp.) is a high Andean herb that was domesticated and widely cultivated in pre-Hispanic times for its edible and medicinal root. It was previously assumed that glucosinolates, macamides, macaenes, and alkaloids were the main bioactive components of maca. However, recently, a series of novel thiohydantoins that generally exhibit a variety of activities have been isolated from maca. Interestingly, thiohydantoins from maca are the first type of thiohydantoin derivatives to be found from a natural source and may contribute to some significant effects of maca (Huang and Qiu 2018). *Schinus molle* L., known in Peru as molle or false pepper, is a tree that grows primarily in the subtropical biome. The essential leaf oils of *S. molle* were characterised by a high percentage of sesquiterpene and monoterpene hydrocarbons. These results are of ecological and economic importance as *S. molle* is a promising species in the pharmaceutical, cosmetic, and chemical industries (Santos et al. 2009).

Copaifera paupera (Herzog) Dwyer is a tree found in the lowlands of Amazonia, which is known as copaiba. Copaiba oleoresin, extracted from the trunk of the tree, contains about 24 sesquiterpene hydrocarbons and various diterpenes, resin acids such as elacic, copaibic, essential oils, turpentine, and a wide range of acids (Egg 1999). Copaifera oleoresins exhibit potential antibacterial activity and are not mutagenic, which makes them a promising source for developing novel natural food preservatives to inhibit foodborne pathogens (Fernandez et al. 2018). *Minthostachys mollis* (Benth.) Griseb. is a climbing shrub that grows primarily in the subtropical biome. It is known as poleo or muña in traditional Andean medicine in Peru. Muña contains an antimicrobial essential oil, proven effective against the potato pathogens *Phytophora infestans*, *Fusarium solanaceum*, ather*winia carotovora*. Thus, the plant is commonly used in potato and grain stores to protect products from these pathogens. The essential oil also exhibits activity against *Shigella dysenteriae*, *Salmonella typhi*, and *E. coli.* (Egg 1999). The genus *Minthostachys* is of significant pharmacological, and commercial interest as essential oils are also present in these plants. Modern pharmacology and medicine are increasingly focusing on this genus, testing plant decoctions and extracted essential oils for their pharmacological effects. The commercial extraction of these essential oils occurs in Argentina and Peru (Schmidt-Lebuhn 2008). Over the past three decades, chemical and biological studies have extensively investigated the genus *Solanum*. Previous studies on phytochemicals in *Solanum* species have identified various compounds, including steroidal saponins, steroidal alkaloids, terpenes, flavonoids, lignans, sterols, phenolic compounds, and coumarins, among others. Several species within this genus have shown a diverse range of pharmacological activities, such as cytotoxic effects against various tumours. The biological activities have been linked to several steroidal saponins, steroidal alkaloids, and phenols (Kaunda and Zhang 2019). From a phytopharmacological perspective, it is noteworthy to mention Peruvian species like *Solanum sessiliflorum* Dunal, commonly referred to as cocona, as its pulp has elevated levels of iron and vitamins (A, C, and niacin), which are especially essential for women and children residing in tropical climates like the Amazon (Egg 1999). *Solanum mammosum* L., native to tropical America, is externally administered to treat leishmaniasis and has strong antifungal, acaricidal, and insect-repellent properties. Solamargine has been shown in vitro to be the most active compound of *S. mammosum* against *T. mentoagrophytes* and *C. albicans*. In addition, this compound significantly affects *P. aeruginosa* pyocyanin production and biofilm, which might explain the traditional use of *S. mammosum* fruits to treat a variety of fungal infections and respiratory disorders (Cabanillas et al. 2021). The root, bark, and leaves of *Abuta grandifolia* (Mart.) Sandwith possess medicinal value, as outlined by Brack (1999), via their action as a cardiac tonic, febrifuge, anti-inflammatory, and anti-contractile agent, and thus are of benefit in the treatment of diabetes, malaria, and typhoid. The leaves of *A. grandifolia* have aphrodisiac properties and are commonly used to treat female sterility and haemorrhage. The present compounds comprise of alkaloids (benzyl-isoquinolinic), saponins, flavones, and tannins (Rengifo 2000). *Equisetum giganteum* L. extract is a promising alternative for topical treatment and the prevention of oral candidiasis and denture stomatitis. It has shown in vitro antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans* as well as anti-inflammatory activity (Alavarce et al. 2015). According to Vieira et al. (2020), this species may be a therapeutically relevant resource in the treatment of diabetes and hyperlipidaemia. A significant component found in *Mansoa alliacea* (Lam.) A. Gentry is ursolic acid, a natural bioactive compound. This natural terpene has been demonstrated to possess cellular protective properties impacting the lung, kidney, liver, and brain structures, anabolic properties on skeletal muscle, and the capacity to inhibit bone density loss resulting in osteoporosis. Additionally, it has exhibited antimicrobial, anti-parasitic, anti-inflammatory, and antioxidant properties (Taylor 2004).

Curare is a term initially attributed to an arrow poison used by native hunters in the Amazon. It is made by boiling the roots, bark, and stems of different plants from the Loganiaceae (*Strychnos*) and Menispermaceae (*Chondrodendron*, *Curarea*, and *Abuta*) families. The curare used in the eastern Amazon region is obtained from diverse species of *Strychnos* known to possess quaternary alkaloids that work to obstruct the neuromuscular junction (Carod-Artal 2012). The application of curare as a surgical muscle relaxant emerged in 1942, inspiring the advancement of improved muscle relaxants for surgical procedures. This progress directly resulted in the development of numerous derivative drugs, such as b-blockers, Prozac, antidepressants, and treatments for asthma, Parkinson's disease, and diarrhoea. An important aspect of the scientific investigation into curare, which began in the 1930s, was that its use as a research tool demonstrated the essential role of chemicals in transmitting messages within the brain and throughout the body, which greatly enhanced our comprehension of physiology and brain function (Dutfield 2010).

3.4.3. Potential of scientifically unexplored species

Scientifically unexplored botanical species are plants that have not undergone a thorough pharmacological or medicinal investigation, even though they have been traditionally used by local and Indigenous communities. A noteworthy percentage of medicinal substances available in the market can be attributed to the knowledge of Indigenous populations, provided that a sincere effort is made to investigate this fact (Dutfield 2010). As tropical rainforests are disappearing, Indigenous cultures and their traditional knowledge are transforming rapidly, before adequate documentation of this valuable knowledge concerning their ancestral practices, including medicinal ones related to the forest (Graham 2001). Sufficient evidence indicates that the loss of traditional knowledge results in the unavailability of a vast and invaluable inventory of intricate biological substances, which scientists are unlikely to discover elsewhere or develop anew in the laboratory. Therefore, it is necessary to support ethnoecological systems that preserve this knowledge through daily usage and uncover more knowledge (Dutfield 2010). Newman and Cragg (2020) of the National Cancer Institute of the United States argue that the use of natural products as sources of new structures, which may not necessarily result in the final drug entity, remains a useful strategy. In the field of cancer research, 73% of the 155 small molecules studied since the 1940s have been non-synthetic, with 47% derived directly from or being natural products. A comprehensive empirical study provides compelling evidence that, as prior research has suggested, "natural products play a significant role in discovering leads for drug development to treat diseases in humans" (Newman and Cragg 2020).

The initial phase in any ethnobotanical research project within a specific cultural context is the documentation of traditional knowledge about medicinal plants (Alexiades 1996). Valuable traditional knowledge about plants and their diverse health properties is held by many Indigenous and local communities. To validate traditional claims, it is essential to determine the ethnopharmacological potential of such unexplored species through systematic research. Subsequently, this could result in discovering new bioactive compounds for therapeutic purposes. In this context, the documented findings should serve as the fundamental basis for such analysis. Within the broader field of ethnobotany, unexplored botanical species have a fascinating potential for ethnopharmacological research. As Dutfield (2010) states “traditional knowledge is a logical starting point as a source of initial leads”.

This thesis is a case study of the traditional botanical knowledge of medicinal plants in the Ucayali region, and specifically the remote province of Purus, home to the Cashinahua tribe. Despite the numerous scientific studies conducted among the Cashinahua, which have resulted in a significant number of ethnographic and linguistic works, knowledge of the therapeutic applications of their plant life remains scarce (Graham 2001). The only systematic ethnobotanical research dealing with the biodiversity of Purus Province (Graham 2003) and the medicinal plants of the Peruvian Cashinahua is the work of James G. Graham (2001). In his research on the medicinal botany of the Cashinahua, Graham highlighted the crucial need to document the knowledge of Cashinahua medicinal flora and its applications. He also emphasised the need for extensive research to preserve this diverse knowledge before the tribe's pre-contact way of life disappears from our collective memory.

The inhabitants of Purus Province are confronted with various health challenges, mainly of a nutritional and infectious nature, alongside those classified as neglected tropical diseases by the World Health Organization. Over 20 poverty-related conditions afflict the population, including snakebites, leishmaniasis, scabies, intestinal parasites, and dengue fever (WHO 2007). Owing to the province's inaccessibility coupled with little state presence leading to the lack of conventional medical facilities, Indigenous populations in this remote tropical region depend entirely on natural resources for their healthcare. The region's isolation means that its diverse flora and traditional medicinal practices have been preserved and used for therapeutic purposes. The Cashinahua people inhabiting this biodiversity hotspot are known to possess extensive knowledge of plant species with medicinal and therapeutic properties, which they utilize to maintain their physical and mental well-being. However, their traditional knowledge has yet to be adequately investigated. Ethnobotanical studies are necessary to have at least a basic idea of the relative importance of the available knowledge (Graham 2001). If neither Indigenous knowledge nor biodiversity can be conserved, then the result is a double tragedy where all will be losers (Alexiades 1996).

This study seeks to enhance the available knowledge on Cashinahua medicinal ethnobotany whilst bridging significant gaps in the scientific literature. It is based on recent, extensive field research conducted on the use of medicinal plants by Cashinahua plant specialists who reside in the Curanja River basin area of Purus Province in the Peruvian Amazon. This research provides essential insights into the traditional knowledge and plant diversity of the Cashinahua people, which can contribute to the development of novel alternatives for healthcare and sustainable economic activities.

3.5. Objectives and research questions

The main objective of this thesis was to gain insight into the relationship of Cashinahua communities with medicinal plants in the context of their biological and socio-cultural environment.

This led to the following research questions:

1. What plants do the Cashinahua use for medicine and how do they use them?

2. Who are the holders of medicinal plant knowledge in Cashinahua society?

3. Do the Cashinahua use some ethnopharmacologically neglected medicinal plant species?

3.5.1. Specific objectives

1. To conduct an ethnobotanical inventory of the medicinal plants used by the Cashinahua people (RQ1).

2. To document the traditional system of Cashinahua phytomedicine (RQ2).

3. To identify potentially neglected medicinal plant species and ethnopharmacological applications (RQ3).

We hypothesise that (1) the Cashinahua use a large number of medicinal plant species for a wide spectrum of health disorders, (2) the use of medicinal plants in Cashinahua society is driven by social and cultural factors, (3) Cashinahua women have significant knowledge of medicinal plants used for the treatment of reproductive health disorders, and (4) the Cashinahua use numerous scientifically neglected medicinal species.

4. Methodology

The study was carried out for 11 months from November 2010 to June 2015, covering both rainy and dry seasons. In addition, a brief trip was made to gather additional plant material and information required for the correct identification of voucher specimens. Data was gathered by conducting open and semi-structured interviews with ten local informants, acknowledged as traditional healers in Cashinahua communities, who possess advanced knowledge of plants (Albán 1985). Because of the male study participants’ limited information on plants used for gynaecological care and female reproductive health, an additional ethnobotanical survey was conducted with ten female respondents – all midwives.

The accuracy of ethnomedical data can vary significantly based on the thoroughness and breadth of the inquiry, the intricacy of the documented medical system, the degree of mutual trust between the researcher and the people involved, and the credibility of the sources of information (Alexiades 1996). Mutual trust with potential participants and their families was established through prior visits to the study communities between 2007 and 2009. The trustworthiness of the information sources was guaranteed through the careful selection of highly regarded plant experts, who were suggested by community members during these site visits. The establishment of a high level of trust between the researcher and study participants played a vital role in enabling open communication within the small indigenous communities located in a highly remote region. The researcher resided with the informants' families, which underscores the importance of trust in such settings. As mentioned, this trust was cultivated during multiple prior visits, during which the researcher openly expressed interest in the tribe's traditional medicine and community lifestyle, establishing some level of reciprocity. This ultimately resulted in the formation of a significant and enduring partnership, leading to collaboration. Owing to the dependence of fieldwork on external conditions, it was not always feasible to visit the study site at the ideal time for collecting fertile samples. As a result, some plants had to be collected more than once, at different periods, to obtain the most accurate taxonomic identification possible.

4.1. Study area

Peru is a decentralised state consisting of 25 departments, each of which is governed by decentralised offices of national ministries. Ucayali department has a population of nearly half a million people, with the majority (81.0%) residing in urban areas and the remaining (19.0%) in rural areas. Ucayali is divided into four provinces, with Pucallpa serving as its administrative centre.

Purus Province is the most sparsely inhabited and isolated amongst all the provinces. It has a population of 2,860 and a population density of 0.16 inhabitants per square kilometre (Lafontaine 2018). The majority of Purus's population, according to census, is Indigenous, as 2,757 inhabitants declared that they belong to an Indigenous people (96%) and only 103 inhabitants identified as non-Indigenous (4%) (Ministerio de Salud del Perú 2009). However, these estimates are inaccurate mainly due to the movement of Indigenous people between Purus and neighbouring regions in Brazil. Because of its geographical position and the hydrographic profile of the area, the only direct connection between the province and the rest of the national territory is by air (FECONAPU 2004).

One of the main tributaries of the Amazon, the Purus River, originates in south-eastern Peru, one of the most diverse and unexplored parts of the Amazon Forest, creating, together with the Madre de Dios region of Peru and Brazil, a huge corridor for life and culture (Fagan and Shoobridge 2007). The watersheds of the Jurua and Purus rivers are separated from the drainage system of the Ucayali River to the west by a series of low hills that do not exceed 400 m.a.s.l. Purus is the highest of Ucayali's four provinces, and its capital, Puerto Esperanza, is located 350 m.a.s.l. The province, which sits between approximately 72° and 71° West Longitude and 9° to 10° South Latitude, has a historical association with the Cashinahua people and is located in a geographically isolated and hard-to-reach area of the headwaters of the Purus and Jurua rivers. Nearly 80% of the territory of Purus Province is under protection, with Alto Purus National Park, at more than 2.5 million ha, standing out as the largest protected area in the country. The Purus River basin and the neighbouring Madre de Dios region are recognised as areas of high biodiversity because of their location, which borders protected natural areas, such as Alto Purus National Park, Purus Communal Reserve, Madre de Dios Territorial Reserve, and Mashco Piro Indigenous Reserve. The entire province lacks any form of road infrastructure, which serves to mitigate the negative consequences of the substantial influx of settlers that inevitably leads to habitat degradation (Graham 2003). The Purus River and its tributaries are navigable by small boats, and these represent an essential means of communication. Purus Province represents one of the few remaining sanctuaries where nature and its associated traditions and knowledge persist. In this relatively undisturbed rainforest area, tribes rely primarily on the traditional use of medicinal plants for health and healing.

4.1.1. Climate

The climate is hot and humid, with an average annual precipitation range between 1800 mm and 2400 mm. The main rainy season is from December to April, and temperature variations throughout the year are minimal (BCRP 2012). Temperature and precipitation patterns from 1990 to 2019 are shown in Figure 1. The climate diagram available for the study area documents climate cell of Balta, the penultimate village in the upper course of the river Curanja. The territory of all the communities in the study is included in this climate cell.

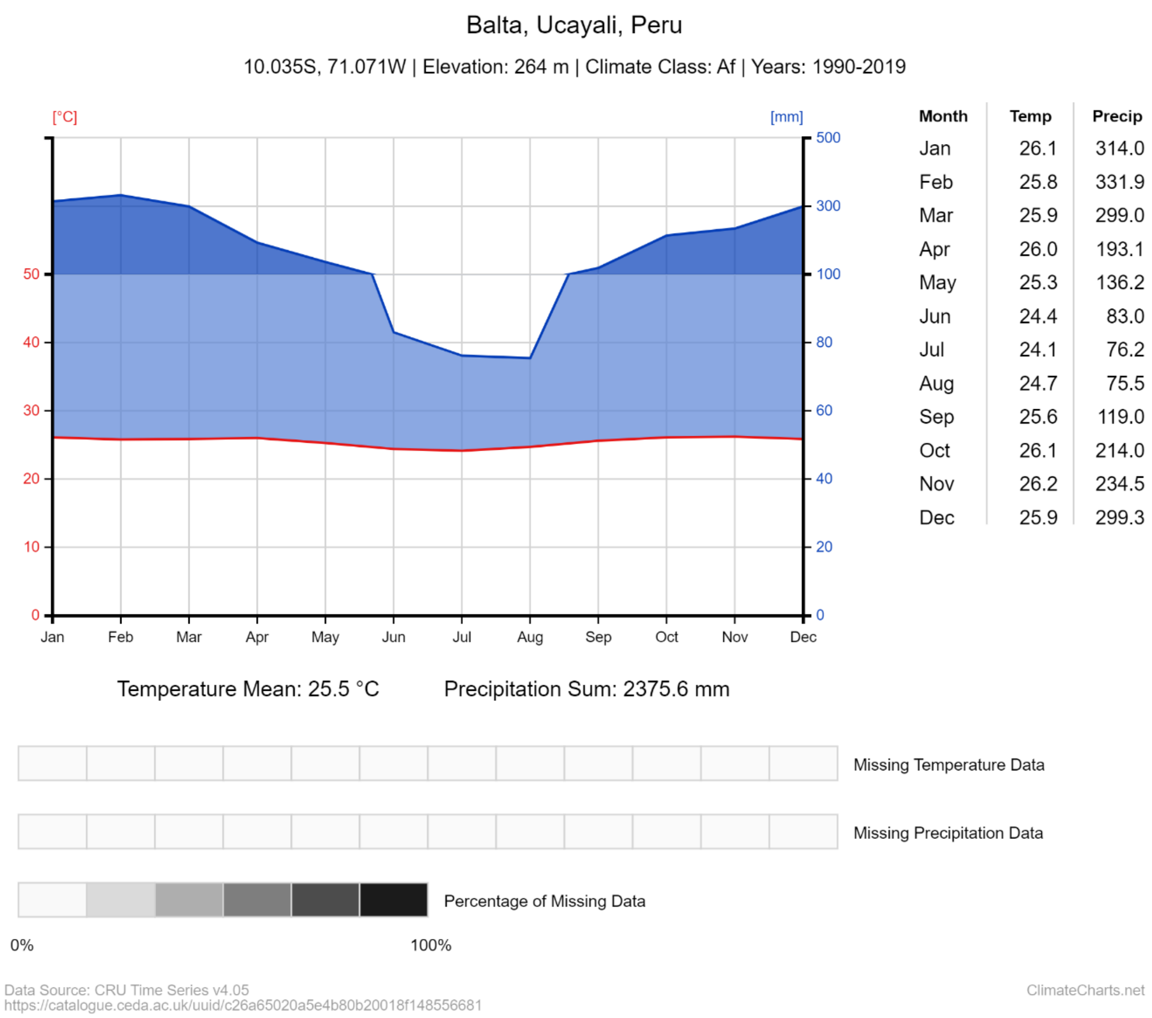


Figure 1. Climate diagram of the study area (Zepner et al. 2021).

4.1.2. Soil

According to the global map of terrestrial ecoregions (Olson et al. 2001), Purus Province is classified within the 'Southwestern Amazon Moist Forests ecoregion'. Over 90% of the analysis area belongs to the same soil unit, composed of Tropudalfs and Eutrochrepts (ONERN 1980). The soils found in terra firma locations include, on average, 52.5% sand, a neutral pH (6.3), and relatively low nutrient levels. A narrow strip of land adjacent to the major rivers is categorised as juvenile alluvial soil and is deemed more fertile than elevated soil, and thus it is of superior quality for agricultural purposes (Pitman et al. 2003).

4.1.3. Study site

In general, the Cashinahua people reside on both banks of the Alto Purus River, spanning the Peruvian and Brazilian sides of the border. The Curanja River - a left tributary of the Alto Purus River - serves as the buffer zone of the national park and is exclusively inhabited by the Cashinahua across seven distinct communities. The study sites for this research (Figure 2) are located in the buffer zone of the Purus Communal Reserve and consisted of the last five Cashinahua communities on the upper stretches of the Curanja River bordering the uninhabited zone of Alto Purus National Park (Figure 3). These communities, which generally reside on the elevated banks of the river bounded by primary rainforest, include Colombiana, the base community with 65 inhabitants, Santa Rey with an estimated population of 96, El Triunfo with 35, Curanjillo with 31, and Nueva Vida with 31 inhabitants. The population estimate is from 2015, yet it is only an approximation due to the semi-nomadic lifestyle of the Cashinahua people. Furthermore, the 2013 census revealed a depopulation of the El Triunfo community, which is currently occupied by different families. This limitation restricted research on the community of El Triunfo to the years 2010 and 2012.

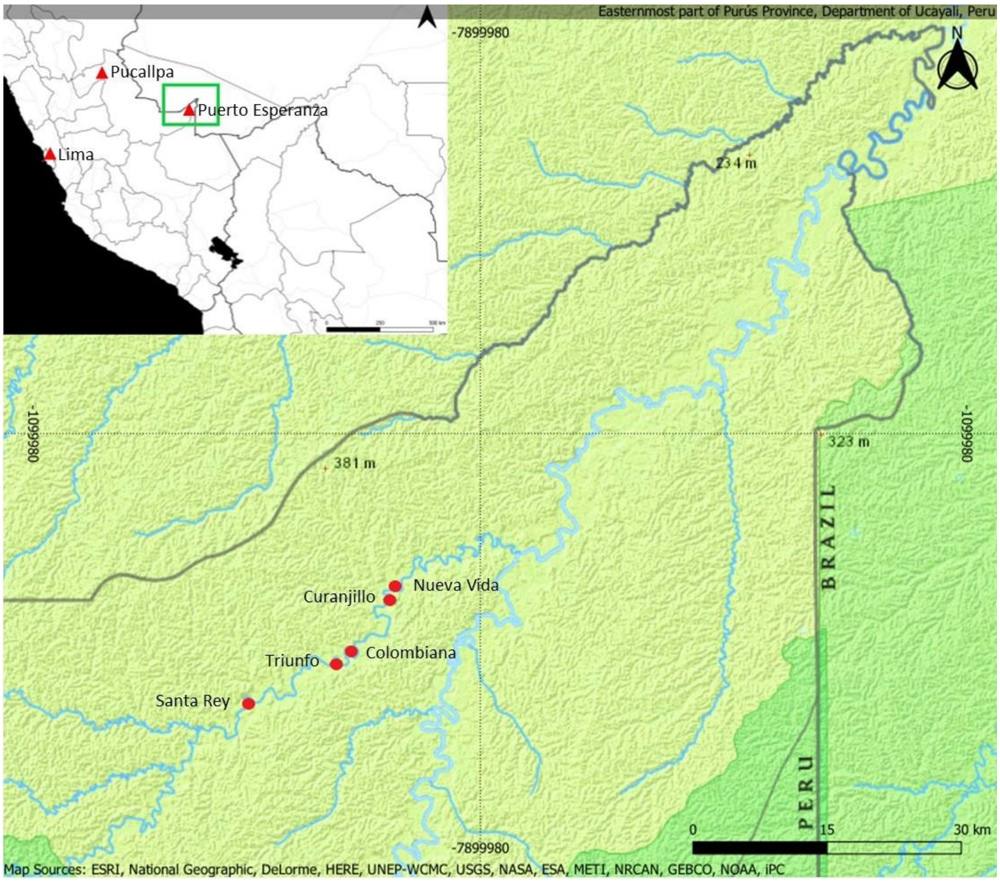


Figure 2. Map of study area (the studied communities are highlighted with red dots.

Titled lands of Indigenous communities on the Purus and Curanja rivers.

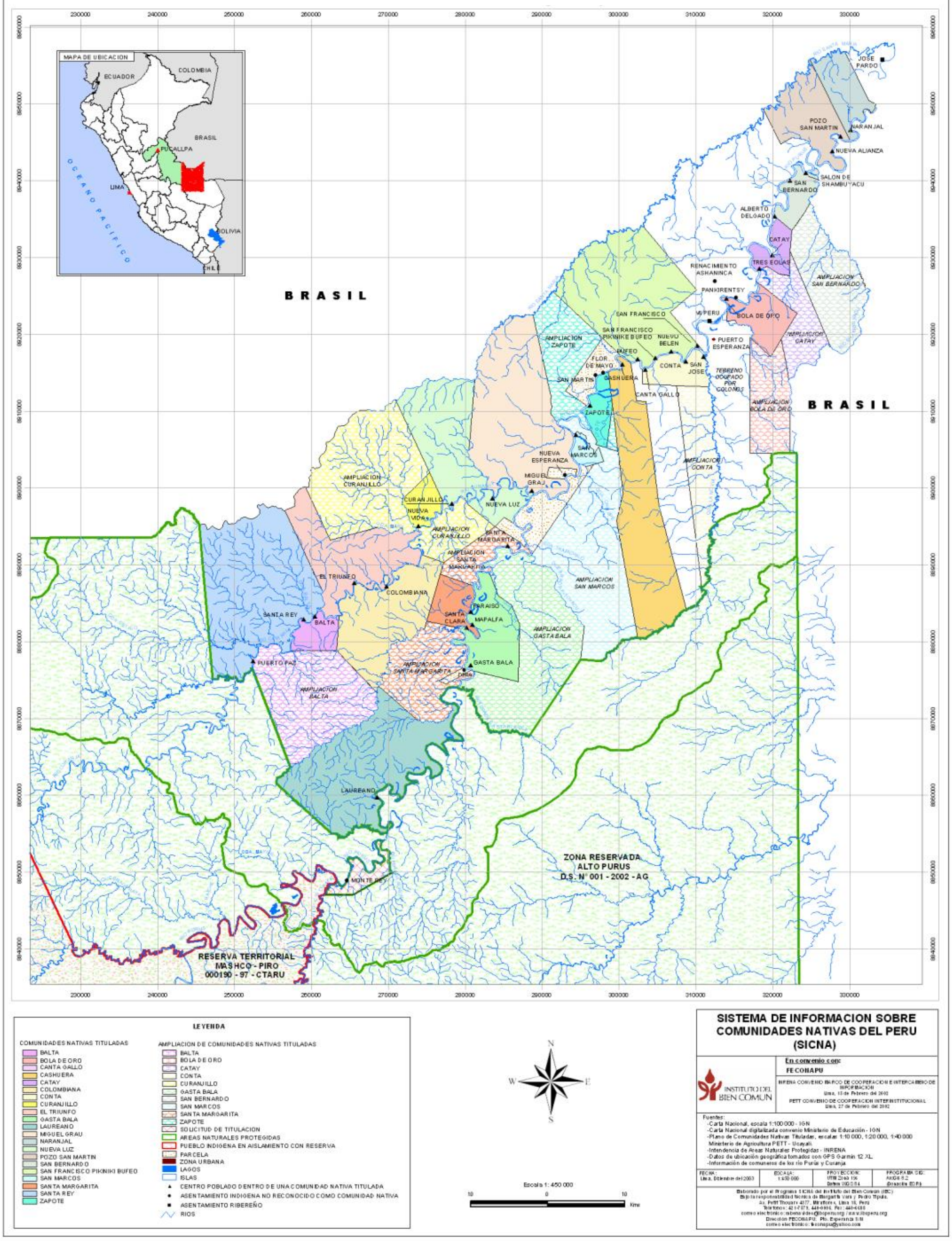


Figure 3. Titled lands of Indigenous communities on the Purus and Curanja rivers (Adapted from: SICNA Sistema de información sobre las Comunidades Nativas del Perú).

4.2. Sampling of communities and informants

The Cashinahua ethnic group was chosen on the basis of published research by Kensinger (1995) and Graham (2001), as well as previous visits to the area between 2007 and 2009. The Curanja River area was selected because it is solely populated by the Cashinahua community. The area's inaccessibility and remoteness implied that traditional knowledge and biodiversity would be preserved. The participating communities were Santa Rey, El Triunfo, Colombiana, Curanjillo and Nueva Luz. The study participants were chosen using a combination of purposive and convenience sampling methods (Espinosa et al. 2012; Tongco 2007), with the chief of every village providing their recommendations for attendees. Purposive sampling is a type of non-probability sampling technique that is most effective when one needs to study a specific cultural domain with knowledgeable experts within it. It can be used with both qualitative and quantitative research techniques. The inherent bias of the method contributes to its effectiveness, and the method remains robust when tested against probability sampling. The selection of a purposive sample is critical to the quality of the data collected, so the reliability and competence of the informant must be ensured (Tongco 2007). Specialist traditional knowledge of endemic species, genera, or families represents both a category of indigenous knowledge and the category of cultural sensitivity and conservation concerns. During the initial stages of the research, two significant male research participants in each local community offered vital plant usage information. These individuals were highly regarded in their societies as traditional herbalists and demonstrated a high level of plant knowledge. Because of the limited information possessed by male study participants regarding plants utilised for female reproductive health issues, an additional ethnobotanical survey was conducted in 2013 and 2015. Ten female informants, who were knowledgeable traditional birth attendants (midwives), were surveyed to explore the medicinal use of plants in the context of family planning, gravidity, labour, postpartum recovery, puerperium, and neonatal protection. Dietary limitations noted in pregnancy and early parenthood were also recorded. The informants' ages ranged from 36 to 77 years. Of the 20 participants enrolled in this research, 75% were aged between 60 and 80 years.

For the household survey, interviews were conducted in every household in four of the participating communities, Colombiana, Curanjillo, Nueva Vida, and Santa Rey. A total of 68 Cashinahua community members participated, including 33 women and 35 men, ranging in age from 15 to 79 years.

4.3. Compliance with ethical standards

A collaboration agreement was reached with the Federation of Indigenous Communities of Purus (FECONAPU) and NGO ECOPURUS (Confederación de Nacionalidades Amazónicas del Perú), while authorisations were obtained from village chiefs and research participants. Informants in the region had previously agreed to the terms of participation, and compensation modalities were pre-negotiated (Alexiades 1996). Prior informed consent for this study was obtained through public meetings held in each village and signed by the respective village chief. During community meetings, the community members agreed on the subject of the study, on the methods to be used, and on eventual economic compensation. The research was conducted in accordance with the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation under the Convention on Biological Diversity. The participants' right to ownership and use of traditional knowledge is preserved, and any use of this knowledge beyond scientific publication necessitates prior consent from the traditional owners, as well as agreement on securing benefits stemming from subsequent use in the Amazon basin. All plant information documented in the *Hantxa Kuin* language during the survey was transcribed by a native speaker from recordings. A hard copy was then returned to the respondents in 2018, along with a supplementary file that included photographs and the vernacular names of the plants collected. The aim of this provision was to stimulate interest in traditional knowledge and cultural conservation within the local community.

4.4. Data collection

Ethnomedicinal plant information was obtained through open-ended semi-structured questionnaires (the questionnaire have been included in Supplementary Materials section as Appendix 3) and informal interviews with plant specialists, together with field notes gathered during the fieldwork. All plant species collected were identified by their common name in the *Hantxa Kuin* language and its translation into Spanish. Medicinal purposes, growth form, plant parts used, and detailed information on the preparation and administration of remedies were documented. Data required for taxonomic identification were recorded in field notes along with georeferencing. Interviews were complemented with direct participant observation of the preparation methods and therapeutic practices associated with the collected species. Additionally, the author considered any dietary restrictions associated with the treatment of illnesses or socio-cultural practices. Field research involved ongoing participant observation while the author resided in the study villages.

The information gathered through participant observation is highly reliable, which makes the technique particularly valuable for documenting the use of plants (Alexiades 1996). Most information was noted and recorded in the *Hantxa Kuin* language and subsequently translated into Spanish with the help of a bilingual facilitator recruited from among local community members. Using native languages to collect data is usually also a precondition for detailed analysis, as language is an important cultural filter, with many concepts and categories lacking equivalent meanings and susceptible to inappropriate translation. Understanding how informants think and speak is key to communicating successfully, allowing one to ask meaningful questions and interpret responses correctly (Alexiades 1996). The quality of the representative ethnomedical information may vary depending on the complexity of the documented healthcare structure, as well as the scope, depth, and level of mutual trust between the researcher and those involved. Because of the sensitive and private nature of the female respondents regarding the intimate details of their remedies, it was occasionally necessary to exclude male participants during the collection of data on plants used by study participants to treat reproductive disorders.

Interviews with plant specialists were conducted in their native language and then translated into Spanish. A native speaker of *Hantxa Kuin* with a good command of Spanish was always present both during the ethnobotanical walks and when recording information on the effects and uses of the plants collected. Questions asked in Spanish were interpreted into *Hantxa Kuin*. Answers were given in this language and then translated back into Spanish. Recordings were created in Spanish and *Hantxa Kuin* throughout the semi-structured diary entries and free interviews. The recorded data was transferred to a laptop computer each night after the recording. Concurrently, a written record of fundamental data for every plant collected was recorded bilingually. Therefore, there are two versions of the written transcript and two versions of the audio recordings. Once all the information on the use of the collected plants had been collected, the audio recordings were transcribed verbatim by a native speaker in *Hantxa Kuin*. They were then digitised. This formed the basis of a comprehensive hard copy that was distributed to key respondents.

In addition to utilising semi-structured questionnaires for customary ethnobotanical investigations, a separate round of interviews was conducted in 68 Cashinahua households, employing an alternative questionnaire design (household questionnaire have been included in Supplementary Materials section as Appendix 4). Interviews with community household members were carried out by a proficient facilitator, commonly a teacher from the same village, who were native speakers of *Hantxa Kuin* and had good command of Spanish. This allowed for more intimate communication between interviewer and interviewee, as Cashinahua elders often spoke *Hantxa Kuin* and did not know any other language. The respondent's name, age, occupation, place of birth, and number of years living in the community were recorded. Participants were asked sequentially to identify the person in their household and community who they believed had the greatest knowledge of medicinal plants. They were also asked to identify the source they relied on for treatment of an illness, such as self-treatment, a traditional healer in the community, a doctor in a nearby town, or others. A detailed list of illnesses that had occurred in their respective households in the past year was provided. This was accompanied by a description of the symptoms, perceived causes, and remedies. Any herbal medicinal remedy stored in the house was recorded and its application described by the informant. Participants were also queried regarding any medicinal species that were growing in their home gardens for emergency situations. Information was also collected on plants that were not actively cultivated but grew spontaneously in the proximity of the house and were recognised as medicinal.

4.5. Voucher specimen collection

During the ethnobotanic survey, we examined different ecological systems in the five selected villages. Whenever feasible, we collected representative samples in triplicate for the botanical specimens (Alexiades 1996). Botanical specimens were obtained through various techniques including field walks, in various ecological locations, with research participants using ethnobotanical walk methodology. During the gathering of botanical samples, field notes were consistently recorded. The data provided pertinent information, including the date of collection, respondent code, specimen code, in-situ digital photo codes, the plant's vernacular name, the collection habitat, as well as the life form of the plant. In addition, field notes included georeferenced data and specific noteworthy details that would only be observable during the identification process, such as scent, flower, and fruit shade or the occurrence of any exudate in any of the plant's individual parts, alongside their respective colours. During the ethnobotanical expeditions, we surveyed the diverse ecosystems surrounding the Cashinahua villages located in Colombiana, Santa Rey, Curanjillo, Nueva Vida, and El Triunfo (in the case of El Triunfo, the community was entirely abandoned due to a raid by a tribe in voluntary isolation in the nearby forests of Alto Purus National Reserve; thus, our work there was only conducted in the years 2010 and 2012). The ethnobotanical walks of comparable length, lasting a maximum of three hours, from the villages of Colombiana, Santa Rey, Curanjillo and Nueva Vida were led by key respondents - herbalists. The routes were chosen to cover all types of habitats in the area. Shorter ethnobotanical walks were also undertaken from the community of Triunfo, with a maximum walking distance of two hours from the village. From the communities of Colombiana, Nueva Vida and Curanjillo, short canoe trips were made to the areas around the smaller tributaries of the Curanja River. The herbalists from each of the communities studied led the way, stopping wherever they found a plant that they had experience of using for medicinal purposes. For most of these plants, geo-referenced data and the plant's habitat were recorded. We collected plants from riverbanks, primary and secondary forests, seasonally flooded forests, and anthropogenic environments such as cultivated areas and the surroundings of houses. All the available information was recorded and transcribed in Spanish and the *Hantxa Kuin* language. Georeferenced data are available on request from the author.

The work schedule of the field survey typically comprised morning plant collection, followed by a return to the village in the early afternoon to conduct semi-structured interviews with research participants. Botanical samples of medicinal plants were gathered by key informants during forest walks, while semi-structured interviews were conducted to ascertain their uses, the plant elements used, as well as their preparation and application. Additionally, plant specialists were engaged in field trips to diverse vegetation zones near the study sites for the collection of plant material. Participants were asked to identify and exhibit any medicinal plants they were acquainted with and utilised, specifying the plant's indigenous name, its Spanish translation, the distinguishing characteristics that enabled identification, and dietary restrictions. For each species, a detailed photographic record was carefully compiled. During the interviews, and utilising the freshly collected, unpressed plant material gathered from forest walks, participants were probed for their knowledge regarding the plants, their vernacular names, and/or uses. After conducting the interviews, the specimens underwent preservation and pressing using Schweinfurth's method for herbaria. The botanical samples were preserved in 96% ethanol and hermetically sealed in thick-walled polyethylene bags and kept for several months in the communities. At the conclusion of each long-term field survey, the preserved specimens were transported to Pucallpa to be processed in the herbarium of the National Intercultural University of the Amazon in Yarinacocha (UNIA).

Digital photographs of every plant were taken during field walks using a Nikon D80 digital camera. Distinctive taxonomic features of each medicinal plant were captured through photographs, covering the structure of the entire plant, its fruits, flowers, and leaf morphology, as well as its habitat. At the beginning of every fieldwork season, we shared the results of our previous year's work with the local community through a compendium titled "*Pei dau*" (healing leaves). The compendium contained photos of plants collected during earlier phases of the project, along with their local names. This compendium proved to be an essential resource as it provided a tangible record of our ongoing research. It also provided a framework for discussing and revising necessary data and, as it grew, contributed to the ongoing understanding of the regional flora of the Cashinahua.

As part of the results presentation of this thesis, a field guide was created featuring digital photographs of 90 neglected Cashinahua medicinal plants with their Latin and vernacular names. This field guide was submitted to the Field Museum in September 2021 and can be accessed at https://fieldguides.fieldmuseum.org.

4.6. Taxonomic identification

After returning from fieldwork, the botanical samples were pressed and dried in the UNIA herbarium facilities. Standard botanical procedures (Alexiades 1996) were followed for adjustments and preparation for identification. MSc Maria Elena Chuspe Zans of the UNIA Herbarium and Dr Mirella Clavo Peralta of the IVITA Herbarium then identified the botanical samples. All voucher specimens were deposited in Peruvian institutions. A complete set of voucher specimens (Hor 1-590) was deposited in the Regional Herbarium of Ucayali IVITA at the Universidad Nacional Mayor de San Marcos in Pucallpa, Peru. A duplicate set of specimens was deposited in the Herbarium of the Universidad Nacional Intercultural de la Amazonía in Yarinacocha, Peru. The nomenclature used follows that of the Plants of the World Online (POWO 2023) and APG IV (Byng et al. 2016).
Following completion of the collection, all voucher specimens were scanned at high-resolution (1240 dpi). Scans of the vouchers are in the author's archive and can be made available on request.

4.7. Data analysis

Completed questionnaires and field notes were transcribed into templates in Microsoft Excel spreadsheets before being merged. Following this, the data was cleansed, correcting missing values and removing outlying values. After data cleansing, both the qualitative and quantitative data sets were analysed using Microsoft Excel functions and contingency spreadsheets. Quantification of the ethnobotanical data first involved converting the collected information into use reports (UR). In this study, one UR corresponds to an event where an informant mentioned the use of a species to treat a particular disease or disorder, and the specific mode of preparation and/or application of an herbal remedy. In order to analyse the cultural importance of an individual species, major categories of uses based on the part of the human body affected by a disorder (e.g., respiratory system, digestive system, muscular-skeletal system) were distinguished (Cook 1995). Systemic disorders (especially infections and inflammation) and culture-bound syndromes formed another category. Some categories were added specifically to reflect the methods of preparing and administering remedies that are specific to the group and study area.

The individual responses for each species in each of these categories were then summed, and the therapeutic uses of the plants were sorted and quantitatively assigned to these categories. Most plant species were classified under several categories. In traditional medical systems, the same plant species is often used to treat different unrelated ailments. To test the homogeneity of ethnomedical knowledge, the informant consensus factor (ICF), as proposed by Heinrich (2000), was calculated to indicate whether or not there is agreement among respondents in the use of plant species in each disease category. The factor was calculated as: $ICF=(Nur-Nt)/(Nur-1)$, where Nur is the number of UR in each disease category and Nt is the number of species used in the same category by all interviewed informants. ICF values range from 0 to 1, where a high ICF value describes a high level of agreement among respondents, indicating that there is a well-defined criterion for selecting species used to treat a disease category. First, all suitable ethnobotanical studies from the Peruvian Amazon and neighbouring regions in Brazil and Bolivia (Alexiades 1999; de Almeida et al. 2023; Odonne et al. 2013; Sanz-Biset et al. 2009) were compared to the medicinal species in the study area. Following González-Tejero (González-Tejero et al. 2008), Jaccard's similarity indices were calculated, and the diversity of medicinal plants was compared. Jaccard's index is calculated as $[C/(A+B-C)] \times 100$, where A represents the number of species in sample A, B represents the number of species in sample B, and C represents the number of species that are shared by samples A and B. Following that, a medicinal plant overlap analysis was carried out. This study allowed us to classify collected species taxonomically, and then contrast the existence of scientific information on their ethnopharmacological, pharmacological, and phytochemical uses, selecting species without reports of use or surveys of active compounds within Web of Science databases between 2018 and 2022. On the basis of this criterion, a total of 79 species that have not been previously recorded or only rarely reported for medicinal or pharmacological use were chosen. These species are presented in Section 5.4 and Appendix 2 of the Supplementary Materials.

Quantification should not be regarded as an ultimate goal but as a tool to explore specific ethnobotanical issues. When analysing ethnobiological data, we often have to form subjective categories that are not always in line with those of the informants (Alexiades 1996). It should be noted that any categorisation from the perspective of Western medicine serves solely as a tool for data processing. The incorporation of plants into this artificial categorisation system, created for illustrative and analytical purposes, does not reflect any traditional hierarchical classification system communicated by the Cashinahua. Additionally, it is vital to acknowledge that the medicinal plants presented in this study do not constitute a comprehensive understanding of Cashinahua traditional medicine, but rather a representation of current samples. As stated above, these classifications are simply a subjective categorisation of the use of certain Cashinahua plants and are provided as a general overview for those who have a biomedical perspective on the aetiology of disease. However, it is worth noting, as Graham (2001) has highlighted, that these categorisations are only useful for comparative purposes and are, at best, artificially created and represent an oversimplification. Such a classification of Cashinahua medicinal plants may have been a misinterpretation of the explanation provided by the research participant. This highlights the communication challenges in cross-cultural contexts. When a Czech interviewer poses a question in Spanish to an interpreter, who then conveys it into *Hantxa Kuin* and subsequently translates the response back into Spanish, which is eventually translated into English, it is understandable that the communicated information only frames the content. Furthermore, the Cashinahua people hold varied perspectives on the aetiology of illnesses, as they often attribute the causes of illnesses to interactions with animals, plants, and other spiritual entities. Consequently, the author consistently inquired about the symptoms indicative of the illness.

5. Results

5.1. Taxonomic diversity of Cashinahua medicinal plants

The study shows that the custodians of knowledge about medicinal plants used for various diseases and injuries in Cashinahua society are mainly male herbalists, while those with deep knowledge about the use of plants for reproductive issues are women. Both genders demonstrated knowledge of the use of plants for family planning and culture-bound species. Knowledge of several dozen basic plants used to treat common ailments and minor injuries is widespread even among children. Currently, the Cashinahua community employs a varied range of botanical remedies for primary and complementary healthcare as a result of their cultural practices, financial limitations, and rainforest isolation. Over four expansive field surveys, 590 medicinal plant samples were gathered, with certain species obtained more than once to ensure viability or provided by informants under a different vernacular name. These 590 collected samples yielded a total of 467 plant taxa used medicinally by the Cashinahua people. All documented species were named in the *Hantxa Kuin* language and accompanied by a translation of the plant name(s) in Spanish. Of the total taxa, 345 botanical samples were identified to species level, 105 to genus level, and 6 to family level, while 11 taxa remained taxonomically unidentified. We can observe, from a botanical perspective, an over-differentiation (Kujawska et al. 2020) of 72 plant species which bear two to four different local names. In six cases, under-differentiation was observed in which the identical vernacular name corresponded to different botanical species.

The Community of Santa Rey and Colombiana contributed the highest number of use reports, with 34.1% and 33.3% respectively. Nueva Vida, Curanjillo and Triunfo followed with 14.1%, 10.6% and 7.8%, respectively. Male herbalists contributed 86% of the records, while female respondents contributed 16%. It is important to note that the author only worked with female respondents during fieldwork in 2013 and 2015, but male herbalists were included in all four study periods. The study only collected information from female respondents on the use of plants to treat reproductive problems. They also reported on cultural practices related to pregnancy, childbirth and the first year of a child's life.

The 467 recorded taxa were classified into 99 botanical families. Figure 4 displays the 20 most prevalent families in this study, each consisting of six or more species. Acanthaceae was the most dominant family with 39 species, followed by Piperaceae and Rubiaceae with 28 and 27 species, respectively, while Araceae and Bignoniaceae each had 20 species. The informants gathered and used the following plant species the most: *Pseuderanthemum lanceolatum* (Ruiz & Pav.) Wassh. with 38 UR, *Leonia glycycarpa* Ruiz & Pav. and *Piper reticulatum* L. with 30 UR each, *Piper aduncum* L., *Uncaria tomentosa* D.C., *Tradescantia zanonia* (L.) Sw., *Abuta grandifolia* (Mart.) Sandwith, *Matisia cordata* Bonpl., *Pseuderanthemum congestum* (S.Moore) Wassh., *Drymonia tenuis* (Benth.) J.L.Clark, *Mascagnia eggersiana* (Nied.) W.R.Anderson, and *Piper leucophaeum* Trel.

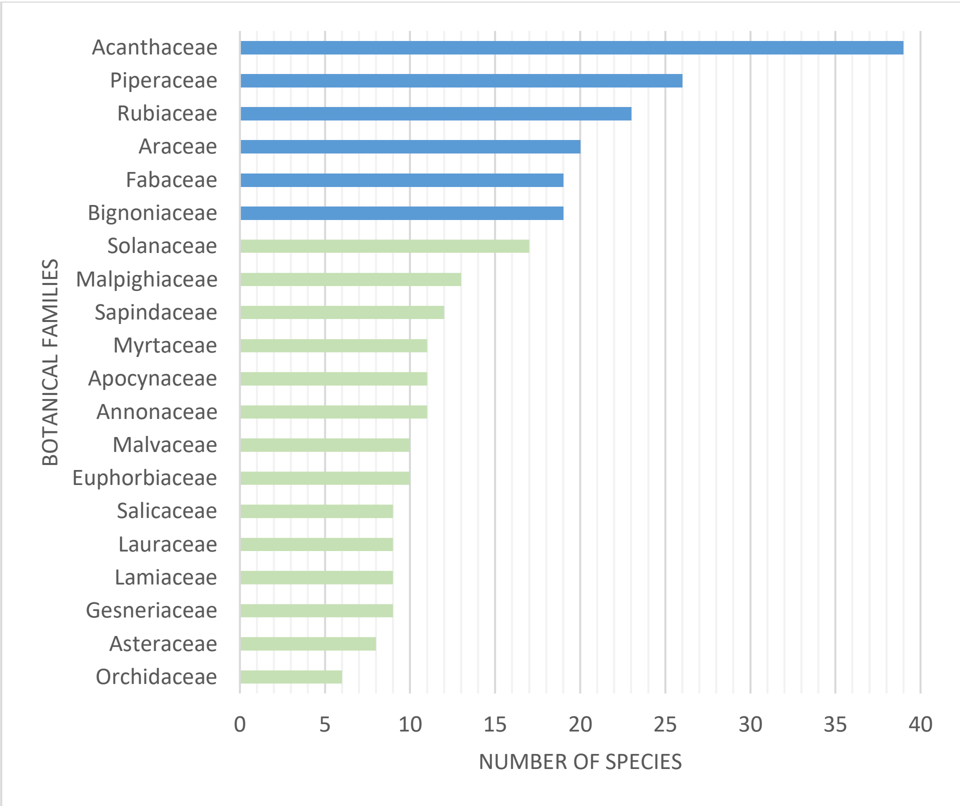


Figure 4. Prevalent medicinal plant families (those represented in the study by 20 or more species are marked in blue). Only the 20 (out of 99 total) families represented by 6 and more species are shown.

As mentioned, Acanthaceae was the dominant family in this study. One representative –species was *Pseuderanthemum lanceolatum - mikin medan putani bata*, used mainly for pregnancy and childbirth disorders, infections manifesting as various forms of herpes, and the treatment of upper respiratory tract inflammation. This taxon, as well as two other *Pseuderanthemum* species, were also used as first aid for venomous snakebites. Another member of this genus, *xuke bibex bata - P. congestum* (S.Moore) Wassh., was used to treat herpes including shingles and cold sores (12 UR), venomous snakebites (6 UR), and eye problems such as–cataracts. *Dunu himi - Pseuderanthemum* sp. was used in 10 cases to treat venomous *Bothrops atrox* bites. One of the most commonly utilised species in the Acanthaceae family was *Aphelandra lasiandra* (Mildbr.) McDade & E.A.Tripp - *yawan kuxi dau*, which was used 'in baths to strengthen a child's body, to treat headaches, and to treat severe convulsions identified by herbalists as the attack of a *yawa* (peccary) spirit or "peccary epilepsy". The chewed leaves of *A. lasiandra* were also pressed into the bites of venomous *Scolopendra gigantea* (Amazonian giant centipede).

The Piperaceae family comprises 5 genera, of which *Piper* (about 2,000 species) and *Peperomia* (about 1,600 species) are the most important. Piper plants grow as herbs, vines, shrubs, and trees and have a broad distribution throughout the tropics and subtropics. The highest diversity and abundance of medicinal species within this family were located in primary forests and adjacent forest edges. Out of a total of 24 *Piper* taxa documented in this research, 14 were identified to species and 10 to genus. The most frequently used species were *Piper aduncum* (31 UR), *P. reticulatum* (30 UR), *P. leucophaeum* (22 UR), and *P. marginatum* and *P. peltatum* L. (11 UR each). The Cashinahua people reported using *P. aduncum* leaves to treat digestive problems, pain, headaches, inflammation, and fainting, as well as to prevent dental caries. *P. reticulatum* was primarily used for prenatal or childbirth care and to reduce high fever. Socio-culturally, it was used for behavioural regulation and for hunting. *P. marginatum* was mostly used to alleviate headaches, to cure inflamed teeth, and to treat scorpion stings. An additional genus of Piperaceae, *Peperomia*, was recorded in this study, with three species documented: *Peperomia blephariphylla* Trel. & Yunck. used for the treatment of tic disorder, *Peperomia swartziana* Miq., and *Peperomia pilosa* Ruiz & Pav.

Plants belonging to the Rubiaceae family have primarily been utilised for socio-cultural purposes. The leaves of *kawa* plants, encompassing various species of *Psychotria*, are frequently incorporated into ayahuasca preparations in the Amazon. The treatment of poisoning, pain, and injury are the most common therapeutic applications of this family. In Rubiaceae (27 spp., 180 UR), *Uncaria tomentosa* (Willd. ex Schult.) DC. had the highest number of reported uses (29 UR).

In the Araceae family, seven genera and 20 species were recorded. *Philodendron* was the most common genus with nine species, including *P. ernestii* Endl. which was used to treat facial paralysis and tic disorders, and *P. fibrillosum* Poepp. which was used in female reproductive health. No literature reports on ethnomedicinal use or phytochemical analysis were found for this species.

The 25 samples of Bignoniaceae included 13 genera and 21 species. The predominant species were *Dolichandra unguis-cati* (L.) L.G.Lohmann with 169 UR, followed by *Cuspidaria floribunda* (DC.) A.H.Gentry, *Tanaecium dichotomum* (Jacq.) Kaehler & L.G.Lohmann, *Jacaranda glabra* (DC.) Bureau & K.Schum., and *Parmentiera cereifera* Seem.

The species most frequently collected and used from other botanical families included *Leonia glycycarpa* Ruiz & Pav. (Violaceae), *Tradescantia zanonia* (L.) Sw. (Commelinaceae), *Abuta grandifolia* (Mart.) Sandwith (Menispermaceae), *Matisia cordata* Bonpl. (Malvaceae), *Drymonia tenuis* (Benth.) J.L.Clark (Gesneriaceae), and *Mascagnia eggersiana* (Nied.) W.R.Anderson (Malpighiaceae). A representation of the most common genera identified in this study is shown in Figure 5.

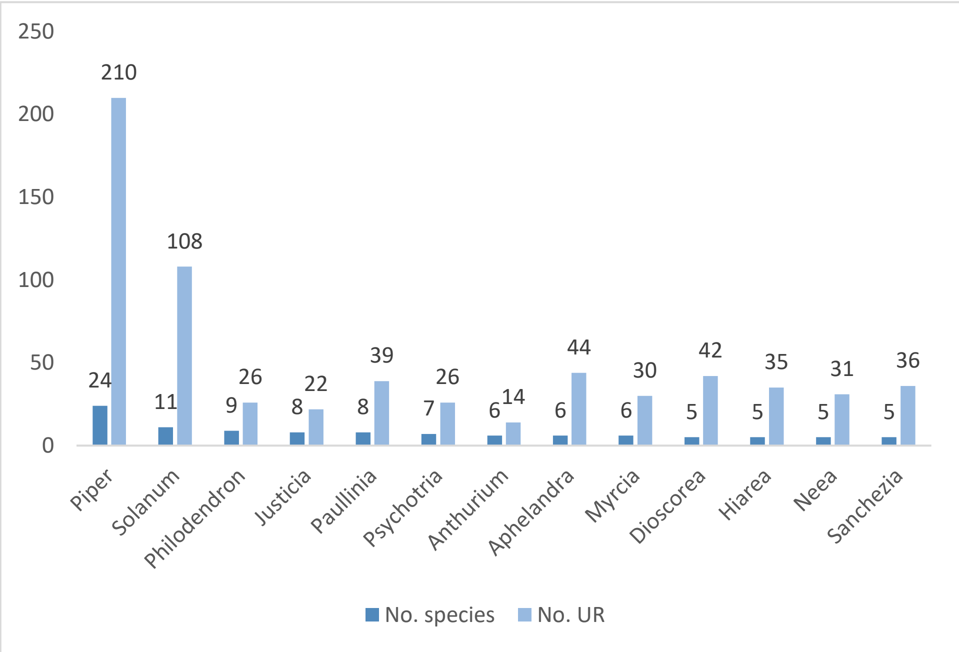


Figure 5. List of predominant genera and the number of species represented. Only the 13 (out of 253 total) genera represented by 5 or more species are displayed.

The genus *Piper* is the most widely recorded taxon in this research, with 24 species and 210 recorded uses. The genus has a number of medicinal uses, primarily for treating digestive issues, maintaining dental hygiene, and managing symptoms of poisonings resulting from the bites or stings of venomous snakes, spiders, and scorpions, as well as for addressing headaches, fainting spells, and skin disorders. It is also known to provide protective benefits during pregnancy and childbirth. The genus *Piper* holds significant cultural value to the Cashinahua, with vast culture-bound applications and central importance in the *Nixpu Pimaa* initiation ritual. The fresh young stems of three *Piper* species (*P. leucophaeum*, *P. hispidum* and *Piper* sp.1), commonly known as *nixpu* (which is the name for most of the species belonging to the genus *Piper* that we have currently documented), have a viscous sap that quickly solidifies and oxidizes on the teeth, turning them black. The blackening lasts for several weeks and is considered by the Cashinahua as a usefulmeasure against tooth decay. Children may only utilise this preventative measure after completing the *Nixpu Pimaa* ceremony.

Solanum is another prominent genus recorded in this study, with 11 species and 108 UR. These taxa include *Solanum arboreum*, *S. barbeyanum*, *S. mite*, *S. nemorense*, *S. oppositifolium*, *S. sessile*, *S. thelopodium*, and four unspecified species. The genus was mainly used in the treatment of snakebites, inflammation, abscesses, and injuries, as well as for socio-cultural purposes.

The genus *Philodendron* is the third most common genus, with nine identified species, followed by *Justicia* and *Paullinia* with eight species each. *Psychotria* comprises seven species, while *Anthuria*, *Aphelandra*, and *Myrcia* each possess six species. *Dioscorea, Hiarea, Neea,* and *Sanchezia* are equally represented with five species each.

5.1.1. Life forms of medicinal plants

Of the documented taxa, herbaceous species were the most frequent (40%), followed by trees (21%), shrubs (15%), and lianas (8%). Additionally, there were climbers (10%), epiphytes (3%), creepers (1%), ferns (1%), one cactus, one moss, and one cycad. The frequency of life forms is presented in Figure 6.

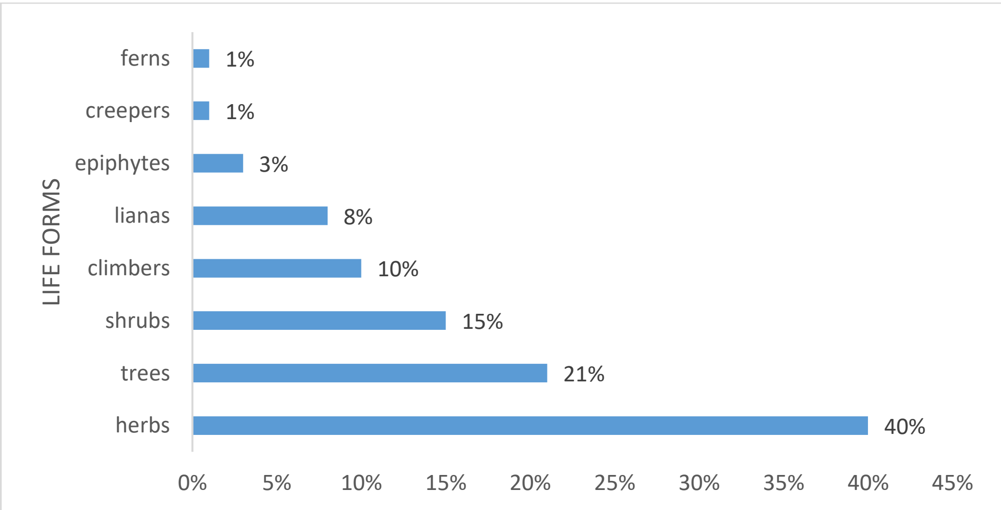


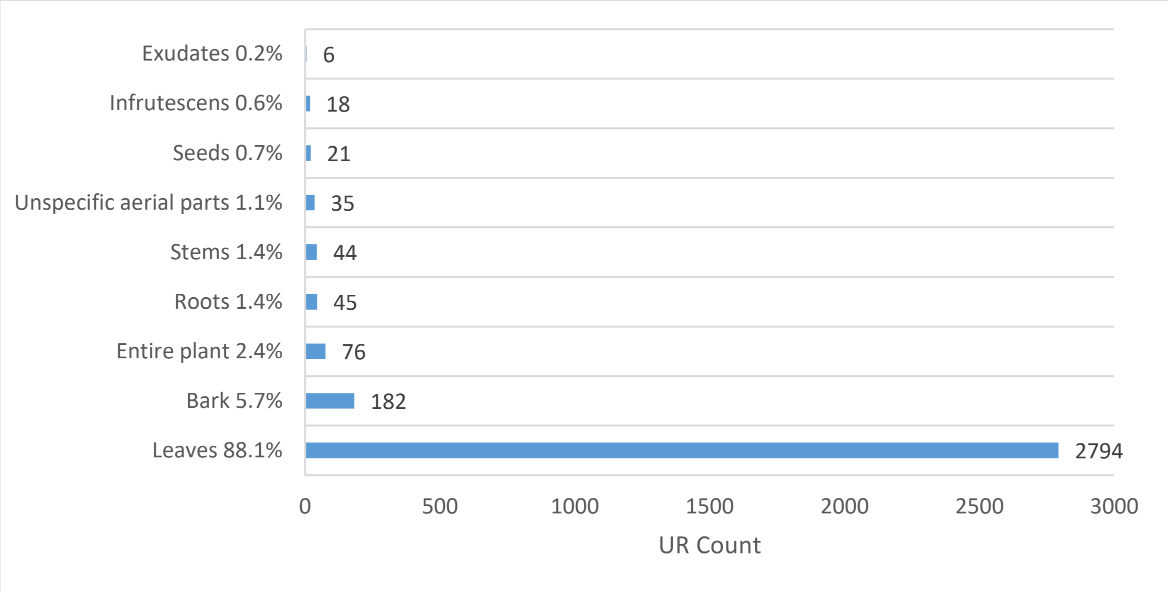
Figure 6. Distribution of life forms of the collected medicinal species.

The prevalent method in Amazonian pharmacopoeia involves utilising primarily herbaceous species and trees. This is likely because they are easily accessible and widely available. Unlike the medicinal use of trees, where bark or exudates are frequently harvested by other Amazonian communities, endangering their survival, the Cashinahua rely heavily on tree leaves. This preference aids in the conservation of these species. It is notable that Cashinahua herbalists preserve pruned, naturally propagated seedlings of trees that possess medicinal properties, guaranteeing that the leaves are readily accessible. The leaves used for medicinal purposes are largely in a juvenile state, thus complicating their taxonomic identification. Because of pruning, seedlings do not have a chance to bloom, resulting in both juvenile and sterile samples being incorporated within the botanical specimens of trees.

5.1.2. Plant parts used

Leaves comprise the main category of plant parts used for medicinal purposes (88.1%), and as such Cashinahua traditional medicine is typically known as *'pei dau'*, or leaf medicine. Stem and root bark usage follows at 5.7%, and then the whole plant, including roots, at 2.4%. Thereafter, the number of applications diminishes in the order of roots, stems, leafy branches, unspecified aerial parts, seeds, infructescences, and exudates in only six cases. Seeds from only a single species were utilised: the seeds of *Sesamum indicum* L. or *xixibin* are applied externally to treat severe medical conditions that do not improve with other medicinal plants. The lightly roasted black seeds are wrapped in a clean white cloth, crushed, and moistened with a small amount of water, and the resulting emulsion is applied to the entire body. In addition, this emulsion, applied only to the abdominal area, is used to help ease childbirth. According to the interviewees, the *xixibin* seeds are obtained through trade with relatives from the Brazilian portion of the tribe. This plant species is among the limited number of medicinal plants introduced and subsequently cultivated by the Cashinahua. The respondents mentioned the use of exudate from only two species. The latex of *Euphorbia hirta* L., a small herb, has medicinal properties for treating cuts, wounds, and removing subcutaneous worms. The sap obtained from the leaves of *Xylosma velutina* (Tul.) Triana & Planch. has also been examined for its therapeutic benefits. It is topically applied to treat tooth decay and alleviate pain and inflammation. The proportion of different plant parts used for medicinal purposes is shown in Figure 7.

Figure 7. Plant parts used for medicinal purposes.



5.1.3. Species origins and gathering patterns

The origin of each species presented in this study was determined by comparison with the Plants of the World Online database (POWO 2023). Most of the medicinal plant species originate from Peru. Figure 8 shows the proportion of collected species belonging to native, endemic, and introduced categories.

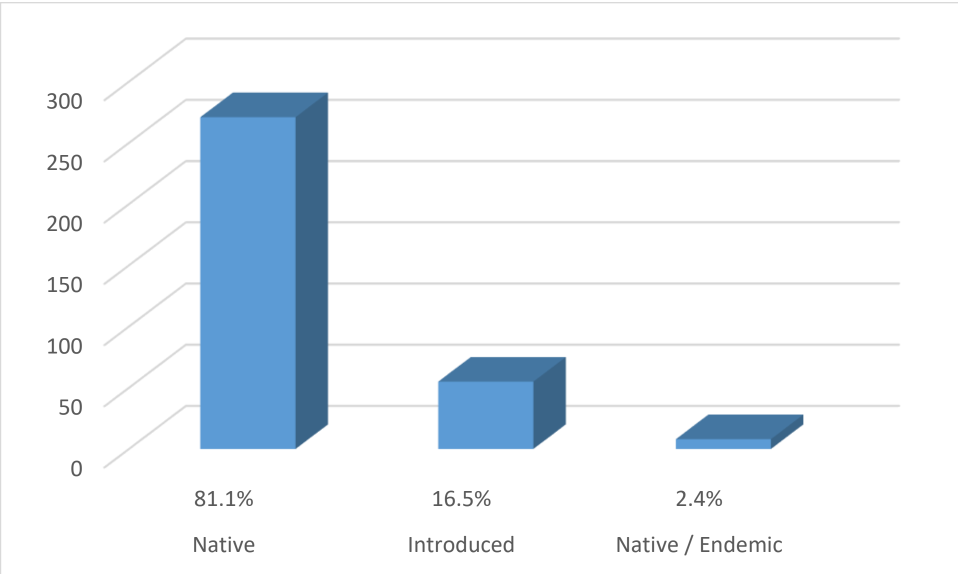


Figure 8. Distribution of native and introduced species in the study collection.

Of the total number of species studied, 277, or 83.5%, were from Peru and neighbouring Latin American countries. Of these, 2.4% of taxa (6 species) were endemic to Peru. Endemic species found within the scope of this study are *Lepidagathis ipariaensis* Wassh., *Justicia aphelandroides* (Mildbr.) Wassh (Acanthaceae), *Asplundia acuminata* (Ruiz & Pav.) Harling (Cyclanthaceae), *Schnella hirsutissima* (Wunderlin) Trethowan & R.Clark (Fabaceae), *Goeppertia sanderiana* (Sander) Borchs. & S.Suárez (Sander) Gentil (Maranthaceae), *Masdevallia pandurilabia* C.Schweinf. (Orchidaceae), *Piper leucophaeum* Trel. in J.F.Macbr. (Piperaceae), and *Paullinia tenera* Poepp. & Endl. (Sapindaceae). Fifty-five of the collected species (16.5%) were introduced from other countries. The main collecting sites of these introduced species were home gardens and anthropogenic environments. The introduced species include flora acquired through exchanges with Kaxinawa relatives living across the border in Brazil, or with individuals belonging to different ethnic groups in the province. According to the interviewees, certain exclusively cultivated species were imported from Pucallpa.

The frequency of distribution of the medicinal plants collected and cultivated in this study is shown in Figure 9. Medicinal plants are mostly collected in the wild, with 85.1% of the documented taxa being collected in their natural habitat. Forty-one of the plants are both wild and cultivated (6.6%) and only 20 species are exclusively cultivated (3.4%). In addition, 30 rare or difficult to find species were either collected in the wild, mostly in places far from the village or transplanted close to houses for the benefit of community members. This indicates a certain tendency towards the initial domestication of these species and also their importance in terms of their therapeutic use.

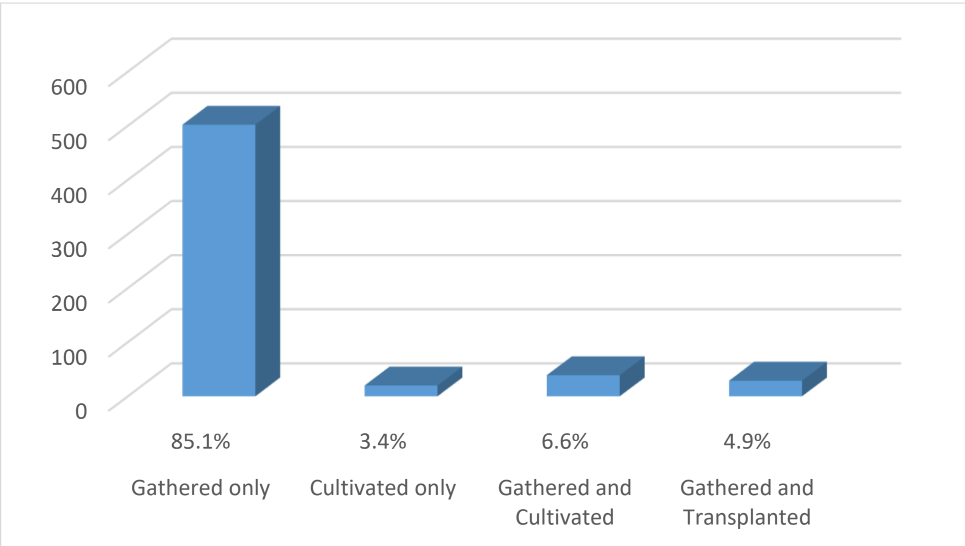


Figure 9. Proportion between gathered and cultivated species.

The distribution of medicinal plant samples among different gathering habitats is depicted in Figure 10. Riparian forests were the most common habitat for gathering botanical samples, with 260 species, i.e., 44.1% of the 590 total botanical specimens. It should be mentioned that some plants were collected more than once during the four long-term field surveys, either because fertile specimens could not be found during the first collection, or because they were introduced under different names by different respondents.

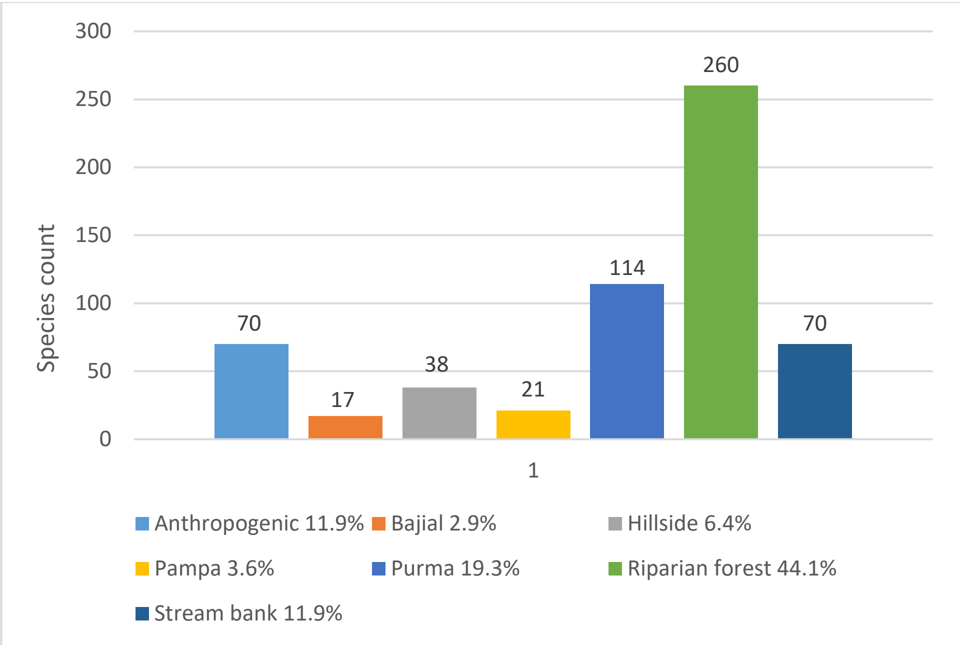


Figure 10. Proportion of medicinal plant species gathered in different environments.

Riparian flora is commonly found along rivers or streams, with varying degrees of proximity to the water's edge. These ecosystems are closely linked to dynamic water flow and soil processes, both of which influence their characteristics. The second most frequent habitat, where 114 species (19.3%) were collected, was "purma", the term used for the growth of plants following deforestation. Seventy species (11.9%) were gathered in anthropogenic environments, with anthropogenic generally referring to "chakras" (fields) or the immediate vicinity of a village or home gardens. A similar number of plant species were also collected from the banks of the "quebrada" (ravine), typically found in a closed valley which maintains a moist microclimate even during periods of severe drought. These plants are mainly represented by the Begoniaceae and Gesneriaceae families. The floodplain forest is interrupted by well-drained terraces and small hills that rise to 50 m, known as "lomas", which are covered in dense vegetation. A total of 38 species, or 6.4%, were collected from the slopes of these "lomas". In South America, "pampas" are wide plains typically covered in grass. There is limited occurrence of such environments in the region, usually only close to villages that rear cattle, and consequently constitute grasslands with soil that is tightly packed and fertilised with cow dung. The "pampas" accounted for only 21 species, or 3.6%, of the collected samples. The least common environment for gathering specimens was the "bajial", where only 17 species (2.9%) were collected. The "bajial" is common in coastal regions and is a low-lying area typically flooded by river water during the flood season.

Most species (80.7%) are gathered from nearby locations, which can be reach within ’one hour on foot from the informants' homesteads. A smaller group of collected plants (19.7% of the total) were collected two to three hours' walk from the community. Some of these were seen to be transplanted by plant specialists into forest gardens near the village for urgent need. The maintenance of these forest gardens was carried out by some of the male study participants.

5.2. Medicinal uses

5.2.1. Reported health conditions treated by medicinal plants

Information was collected on the medicinal uses of the 467 plants studied, as well as specific health problems associated with each plant species, as reported by the study participants. The most frequently reported health issues, as documented in the semi-structured surveys with herbalists, are displayed in Table 1. The botanical species typically utilised to provide treatment for these ailments are also mentioned.

Table 1. Most frequently reported health conditions and species with the highest citation frequency for their treatment

Medical condition	UR	Prioritised species (family), number of use reports
Venomous bites	2276	*Solanum thelopodium* (Solanaceae), 15
Fainting	1182	*Dolichandra unguis-cati* (Bignoniaceae), 14
Childbirth	1161	*Piper reticulatum* (Piperaceae), 17
Headache	1113	*Lacmellea edulis* (Apocynaceae), 9
Dizziness	1109	*Dolichandra unguis-cati* (Bignoniaceae), 12
Seizures/epilepsy	996	*Strychnos tarapotensis* (Loganiaceae), 7
Diarrhoea	884	*Oxalis leptopodes* (Oxalidaceae), *Sanchezia oblonga* (Acanthaceae), 7
Vomiting	881	*Piper heterophyllum* (Piperaceae), 8

Medical condition	UR	Prioritised species (family), number of use reports
Dental health	661	*Geophila macropoda* (Rubiaceae), 9
Fever	557	*Esenbeckia febrifuga* (Rutaceae), 12
Tumour	554	*Ficus gomelleira* (Moraceae), 13
Abscess	553	*Solanum nemorense* (Solanaceae), 9
Sting	553	*Aegiphila cuneata* (Lamiaceae), 8
Bleeding	552	*Hiraea fagifolia* (Malpighiaceae), 8

UR = Use Report. The most common health conditions listed in descending order of UR value.

Most commonly occurring ailments are typically not severe, particularly among adults. Symptoms including diarrhoea, fever, cough, or headache are often untreated for one to several days, provided they are manageable and do not worsen. Seeking an herbalist is typically prompted by worsening, severe, or persistent symptoms. Children are particularly susceptible to illness, prompting earlier medical intervention. For younger patients, the initial preference is to consult a health promoter in the community, who may have medication for common issues, like diarrhoea or pain, to alleviate symptoms swiftly. Subsequently, herbal treatment is chosen by the patient (detailed information on treatment options can be found in Section 5.2.1). It is important to note that Cashinahua plant specialists do not directly treat patients, but instead locate appropriate plants to treat specific symptoms and provide them to the patient with instructions for their use. If an herbal remedy fails to alleviate symptoms within 3-5 days, it may indicate that a more potent treatment is necessary, and the herbalist should seek alternative treatments using other plants. On the basis of these results, the herbalist can then retrospectively estimate the correctness of the diagnosis and the effectiveness of medicinal plants. The elimination of symptoms is viewed as proof of efficacy and accurate diagnosis. The treatment administered before the resolution of symptoms is considered to be responsible for the cure. This raises questions about the effectiveness of previous treatments (Alexiades 1999b). Consequently, conducting experiments is essential for establishing individual criteria to evaluate the efficacy of different plant species. If a patient does not respond to initial treatment, it is often considered an indication of a more severe condition. In such cases, a shaman or physician with specialised expertise must provide further medical attention which might necessitate seeking treatment through conventional medicine. Unfortunately, such medical facilities are unavailable in the area. In cases where a severe ailment fails to respond to prolonged use of natural remedies, the patient is typically conveyed to Puerto Esperanza, which is the sole health center in the region that has a laboratory on the premises. If required, transfer to the hospital in Pucallpa is subsequently arranged. It should be noted that the study communities are several days away from Puerto Esperanza by boat. Additionally, transportation to Pucallpa can only be achieved by air, which poses challenges related to the economic situation of the patient and their family, as well as the irregularity of flights.

5.2.2. Main therapeutic use categories

All 467 plant taxa recorded in this study are used in a variety of contexts, such as treating various ailments and injuries, managing social relationships, improving hunting skills, protecting pregnancy, inducing childbirth and promoting the development of healthy and strong infants, as well as regulating fertility. As mentioned in Section 4.7., data on ailments categorised by affected body part, socio-cultural use, preparation, and use of plant parts have been incorporated into Cook's (1995) category system. Table 2 shows the most commonly reported categories of health conditions by ICF value.

Table 2. Ailment categories presented according to descending order of informant consensus factor (ICF)

Ailment category	UR	% of total UR	ICF	Species count
Pregnancy/birth disorders	275	8.7	0.80	54
Poisonings	311	9.8	0.79	65
Nervous system disorders	192	6.1	0.71	56
Injuries	154	4.9	0.70	46
Sociocultural uses	398	12.6	0.68	128
Infections/infestations	292	9.2	0.67	98
Ill-defined symptoms	201	6.4	0.66	70
Digestive system disorders	246	7.8	0.65	86
Inflammation	178	5.6	0.62	68
Genitourinary system disorders	141	4.5	0.62	54
Unspecified disorders	113	3.6	0.61	45
Pain	178	5.6	0.59	73

UR = Use Report, ICF = Informant Consensus Factor, Species count = overall number of species used for a specific ailment category. Note that a taxon may be (and usually is) reported in more than one category.

In traditional Cashinahua medicine, the same plant species is frequently used to treat various unrelated ailments. To test the uniformity of ethnomedical knowledge, the informant consensus factor (ICF) assessed whether respondents agreed on plant species usage in each disease category. ICF values range from 0 to 1, and a high ICF value indicates that there is a well-defined criterion for selecting a species used to treat a disease category. From the health categories, the strongest agreement among respondents on the use of plant species (the highest ICF value) was evident for pregnancy/birth disorders and poisonings/bites, nervous system disorders and injuries, while the highest number of UR was recorded for socio-cultural uses (398), followed by poisonings (311), infections/infestations (292), and pregnancy/birth disorders (275) as shown in Table 4.

The majority of uses in our study represent poisonous bites (311 UR), resulting particularly from snakebites as well as stings and bites from other venomous animals, including scorpions and spiders. Plants for treating snakebites were always the first to be mentioned to us by the research participants and are considered the most important. Poisonings are imminently life-threatening and encounters with venomous snakes in the study area are common. The most common and dangerous bites come from *Bothrops* spp. – *shanu* or "jergón" in Spanish - and *Lachesis* spp. - *kamux* or "shushupe". We were provided with a comprehensive three-stage treatment for snakebite by all the Cashinahua plant experts we talked to. The plant for the first stage (35 species) - emergency - is determined based on the species of reptile, and always administered externally by squeezing the juice of chewed leaves (or leaves mashed with a few drops of water) into the wound every 3-5 minutes until the patient passes stool, which is considered the moment when the venom is eliminated. The most important plant for the first stage of treatment was considered to be *Rosenbergiodendron longiflorum* (Ruiz & Pav.) Fagerl - *besti bata*, which was used for both *shanu* and *kamux*, although the types of venom are different. *Casearia obovalis* Poepp. ex Griseb. and *Mascagnia eggersiana* (Nied.) W.R.Anderson leaves are frequently used in an emergency to treat different Viperidae bites. *Lygodium venustum* Sw. is utilised in the treatment of *Bothrops bilineatus* bites, while the leaves of *Mascagnia eggersiana* (Nied.) W.R.Anderson, *Caamembeca spectabilis* (DC.) J.F.B. Pastore, *Solanum sessile* Ruiz & Pav., and *Solanum thelopodium* Sendtn. are used to treat *Lachesis muta* bites. The second stage of treatment, that of inflamed wounds, primarily involves bathing the affected part in an herbal decoction (28 species), accompanied by the ingestion of small doses of the same remedy 3-4 times a day, or rubbing the site with leaves pounded in cold water with the same frequency. The final third phase serves to recover the physical strength of the recuperating patient, and can involve 3 species: *Dracontium spruceanum* (Schott) G.H.Zhu, the corm of which is widely used as a snakebite treatment in the Amazon (Lock et al. 2016), *Cardiospermum halicacabum* L., and *Solanum mite* Ruiz & Pav. Phytochemical screening has revealed that *C. halicacabum* extract contains glycosides, carbohydrates, flavonoids, phytosterols, phenolic compounds, and saponins (Zalke et al. 2013). During all three phases of treatment, the patient must not move and remain lying in a hammock. According to traditional Cashinahua medicine, the treatment of any venomous snakebite is only successful if strict dietary taboos are obeyed; neither the patient nor his healer must eat cooked cassava throughout the treatment, otherwise the wound remains inflamed. In the event of dietary non-compliance, the inflammation becomes chronic and is treated by rubbing the wound with the leaves of *Lepidagathis ipariaensis* Wassh. pounded in a small amount of fresh water.

Scorpion stings pose a significant health concern in numerous regions across the globe and are frequently disregarded due to the uncertain prevalence of scorpion poisoning, as many affected individuals do not seek medical treatment. Scorpion stings can be fatal to young children or result in severe health complications, and thus the prompt administration of an antidote is highly effective. *Nixpu bayai* (*Piper leucophaeum)* was the most widely used species in scorpion sting therapy followed by *nidu buxka matsi* (*Piper marginatum* Jacq) and *nixi bata* (*Bunchosia* sp.). Slightly grated leaves of the former species are prepared in the form of *kawa* “patarashca”, and the warm juice is repeatedly squeezed into the wound.

Of the venomous insect bites, the most widespread are that of the “isula” or *buna* ant and the Brazilian wandering spider or banana spider (*Phoneutria nigriventer*) - *xina xuku*. The *buna* ant or giant/bullet ant (*Paraponera* sp.) is a species of hymenopteran insect of the family Formicidae and the only living member of the genus Paraponera. *Piper leucophaeum* was the most used species in isula and spider bite therapy, along with several Salicaceae taxa such as *Casearia obovalis* Poepp. ex Griseb., and *Lunania parviflora* Spruce ex Benth. The most frequently used species to cure venomous spider bites was *Aegiphila cuneata* Moldenke.

In this study, the second most frequently cited health category was infections and infestations (291 UR), which encompassed various types of herpes, leishmaniosis, conjunctivitis, and general infestations. The species with the greatest number of UR in this group were *Pseuderanthemum congestum* (S.Moore) Wassh. (13), *Esenbeckia febrifuga* (A.St.-Hil.) A.Juss. ex Mart. (12), *Pseuderanthemum lanceolatum* (11), *Drymonia tenuis* (Benth.) J.L.Clark, and *Piper leucophaeum* (10 each). According to our findings, *Jacaranda glabra* (DC.) Bureau & K.Schum. leaves were used to treat advanced states of leishmaniosis (8 UR). Strong antiherpetic activity is attributed to 21 species, among which the most cited are *P. congestum*, *P. lanceolatum*, *Caamembeca gigantea* (Chodat) J.F.B. Pastore, and *C. spectabilis* (DC.) J.F.B. Pastore.

Female reproductive disorders were the third most referenced category (274 UR). The species used during gestation, childbirth, and the postpartum period were referred to as 'female's plants', and included *Matisia cordata* (24 UR), *Piper reticulatum* (23), *Tradescantia zanonia* (20), *Theobroma* *cacao* L. (19), *Pseuderanthemum lanceolatum* (18), *Quararibea wittii* K.Schum. & Ulbr. (17), *Acalypha diversifolia* Jacq. (10), and *Tradescantia zebrina* Bosse (9). Apart from *P. reticulatum*, all these plants contain mucilaginous substances (*bixtun*) and are applied to "increase the phlegm" in the woman's womb, which is considered conducive to healthy foetal development and believed to be useful in facilitating childbirth. When contractions begin, liquid from the leaves of *P. reticulatum* crushed in cold water is ingested to accelerate childbirth. *Urceolina cyaneosperma* (Meerow) Christenh. & Byng and *Pavonia fruticosa* (Mill.) Fawc. & Rendle are used together to facilitate delivery.

In the treatment of digestive system disorders, the Piperaceae family predominated. Different species of *Piper* were frequently used for diarrhoea, vomiting, and constipation. Other species included *Xylosma tessmannii* Sleumer, *Uncaria tomentosa* (Willd. ex Schult.) DC., *Oxalis leptopodes* G. Don, *Sanchezia oblonga* Ruiz & Pav., and *Adenocalymma impressum* (Rusby) Sandwith.

Plants frequently cited as efficacious in treating other significant health conditions include *Brosimum guianense* Huber ex Ducke used for bronchitis and pneumonia. *Forsteronia graciloides* Woodson was mentioned by six participants in the study as the universal plant for treating all types of inflammation. In addition, *Caamembeca gigantea* (Chodat) J.F.B. Pastore leaves are used in the treatment of blurred vision, and Cashinahua herbalists utilise the leaves of *Justicia lineolata* Ruiz & Pav. to treat hearing loss.

5.2.3. Culture bound uses

According to Cook's (1995) categorisation, socio-cultural uses are classified into three groups: unspecified socio-cultural uses, religious uses, and anti-fertility agents. Table 3 presents the proportion of these three categories among the collected species.

Table 3. Proportion of socio-cultural uses among the collected species

Category	UR	% of total UR	ICF	Species count
Sociocultural uses (total)	**397**	**12.6**	**0.68**	**128**
Unspecified socio-cultural uses	328	10.4	0.67	110
Religious uses	14	0.4	0.77	4
Anti-fertility agents	56	1.8	0.76	14

UR = Use Report, ICF= Informant Consensus Factor. Categories of socio-cultural uses listed in descending order of UR value.

The highest ICF value was found in the religious use category. *Nixi pae* (ayahuasca) preparation is associated with all species listed in this category. This study documented 397 unspecified socio-cultural uses of plants, primarily for preventing and treating *yuxin* (spirit) attacks, soothing an inconsolable baby throughout the night, protecting women during pregnancy, enhancing hunting skills, and regulating behaviour. In addition, the plants have been used to cure cultural syndromes which are common in Amazonian and Andean regions. These include afflictions such as 'daño' (sorcery), 'cutipado' (revenge), 'panema' (misfortune) and 'afaz' (bad luck in hunting), which are often perceived as magical-religious in nature. 'Cutipado' (revenge) (Jauregui et al. 2011) is a condition that can be brought on by failing to adhere to the recommended diet whilst taking a specific herbal remedy, causing symptoms such as skin blemishes or impaired functionality like dizziness or fainting. Cutipado is commonly treated using the herb that caused it, but only when the recommended restrictions are strictly adhered to. Additionally, the influence of the 'mother' or spirit of a particular animal can cause 'cutipado' if the correct method of killing is not employed, particularly in regard to large snakes (personal communication). The term 'afaz' denotes unfortunate hunting outcomes. Cashinahua men have always prided themselves on being accomplished hunters, which is a crucial aspect of their masculine identity. Meat is preferred as the most essential food among the Cashinahua, and each man must feed his family, including his wife's family, with the game that he hunts, which is why the issue of 'afaz' is greatly feared by the community. Table 4 lists the main uses mentioned in this category in descending order of UR. Maladies such as 'mal aire' (bad air), 'mal viento' (bad wind), 'susto' or 'espanto' (fright), 'mal ojo' (evil eye), and 'daño' or 'brujería' (sorcery) are prevalent among both Amazonian and Andean populations (Bussmann et al. 2010). Causes of illness may stem from sudden shifts in body temperature ('mal aire' or 'mal viento'), exposure to shocking events ('susto' or 'espanto'), spells cast by others ('mal ojo'), or cursing. Table 4 shows the proportion of plant uses in different unspecified socio-cultural contexts.

Table 4. Various contexts in the unspecified socio-cultural category, in descending order of use reports (UR)

Reason for treatment	Number of UR
Yuxin or spirit attack (prevention/treatment)	85
Child crying throughout the night	73
Pregnancy (protection/divination)	64
Unsuccessful hunting	44
Behavioural management	34
To facilitate learning	21
Protection (child/adult/chacra)	20
For fast walking	20
'Afaz' (bad luck)	18
To calm the mind	17
'Daño' (witchcraft)	16
To be good at working	16
'Susto' (frightening)	14
Insanity	13
Encouragement	11
Dizziness after killing a snake	8
'Puzanga' (love charm)	7
To detach a child from the mother	6
Nixpu Pimaa (the initiation ritual)	6
Separated families/separation	6

UR = Use Report. Unspecified socio-cultural uses listed in descending order of UR value.

The prevalent treatment in this category was to cure symptoms interpreted as a spirit (*yuxin*) attack. Our findings confirm the statement of Graham (2001) that if a *yuxin* attack were elevated to the rank of illness, it would constitute the most common category of disease reported for the Cashinahua. It would be easy to interpret this as a folk belief, but when asked about the symptoms that such an attack manifests, the research participants describe convulsive seizures, often accompanied by the loss of consciousness; the affected person is disoriented, suffers great anxiety, and cannot control their basic needs. From the point of view of biomedically defined disease states, one might interpret the symptoms of a *yuxin* or spirit attack as indicative of some sort of nervous disorder but would never consider a spirit to be an etiologic agent. Graham (2001) states that defining and identifying the category of spirit attack is particularly problematic. Treatments in this category include both the use of plants to treat the after-effects of a spirit attack, whose symptoms range from unconsciousness to catatonia to violent rage, and the use of plants to protect someone from a spirit attack. In the latter case, plant juice or a decoction is typically taken internally. Warm baths, the application of plant juice to the eye, or both, are typically used in an emergency.

For religious use, only four taxa were presented by research participants, including *Banisteriopsis caapi* (Spruce ex Griseb.) C.V.Morton bark and the leaves of two *Psychotria* species, namely *P. viridis* and *P. alba,* used together in the preparation of the traditional *nixi pae* (ayahuasca) entheogenic brew. Another plant species that is added to this vision-inducing potion is *Renealmia breviscapa* (Poepp. & Endl.) Poepp. & Endl., whose leaves are included in the concoction when the potion is brewed to "clarify the vision". As stated by Alexiades (1999), ayahuasca is undoubtedly the most widely employed hallucinogen in western Amazonia. Most, if not all, Indigenous cultures use hallucinogenic plants as a fundamental part of their healing practices. They frequently play a role that is significantly greater than that of direct therapeutic and calming methods. Research into the tribe's medicinal plants must therefore include plants used in rituals (Schultes and Raffauf 1990).

Fourteen of the documented species are used as anti-fertility agents in family planning, the most important of which are *Chondrodendron tomentosum* Ruiz & Pav., *Clitoria pozuzoensis* J.F.Macbr., *Faramea multiflora* A.Rich. ex DC., and *Rourea amazonica* Radlk.

With regard to family planning, most Cashinahua women are familiar with the routine use of various plants for long-term contraception. This typically involves undergoing several vaginal baths utilising a concoction of bark and leaves, followed by ingesting a small quantity of the same mixture. The effectiveness of these potent herbal remedies relies on strict adherence to a particular diet and sexual abstinence while using the remedy. The duration of treatment varies from one to two months, depending on the intended length of protection. The duration of protection provided by these measures ranges between 2-3 years. Table 5 displays the species categorized as anti-fertility agents in Cook's system.

Table 5. Species used as contraceptives listed in descending order of use reports (UR)

Genus, species, author	Cashinahua name	Plant part(s) used	UR
Chondrodendron tomentosum Ruiz & Pav.	*avateux muka*	bark root, roots, leaves	13
Clitoria pozuzoensis J.F.Macbr.	*nenautsi himiya (tene kabia nenautsi)*	leaves, bark root, roots	12
Arrabidea sp. 4	*kape hatu nenautsi*	leaves, bark root	8
Faramea multiflora A.Rich.	*xane tsamatininwan*	leaves	4
Talisia cf. *sylvatica* Radlk.	*kespin xanichin nenautsi*	leaves	4
Adiantum poeppigianum (Kuhn) Hieron.	*xanchu xeta nenautsi*	leaves	2
Coussarea sp.	*dunu nami mecha*	leaves	2
Cuspidaria floribunda (DC.) A.H.Gentry	*himi kains*	leaves	2
Hamelia Axillaris Sw.	*xawan himi*	leaves	2
Paullinia anomophylla Radlk.	*xawan maxka bunpa*	leaves	2
Piper cf. *lanceolatum* Ruiz & Pav.	*matsi pei tadunua*	leaves	2
Rourea amazonica Radlk.	*nenautsi himiya (tenekabia nenautsi)*	leaves, bark root	2
Alchornea cf. *costaricensis* Pax & K.Hoffm.	*xeins*	leaves	1
Adiantum platyphyllum Sw.	*xanchu xeta nenautsi*	leaves	1

UR = Use Report.

If a woman decides to discontinue the use of contraception and seek conception, she can use herbs that enhance fertility and counteract the previous contraceptive treatment. This remedy includes a variety of plants known locally as *nanpen tsiwa*, consisting of *Achimenes* sp., *Justicia boliviana* Rusby, and *Stenostephanus* sp. The term *nanpen* refers to a green fly known for its high and rapid reproductive rate. The following plant species, in addition to *Ruellia proxima* Lindau, are used to address female sterility or to counteract the effects of previously used contraceptives: *Pentagonia amazonica* (Ducke) L. Andersson & Rova, and *Urceolina cyaneosperma* (Meerow) Christenh. & Byng.

5.2.4. Modes of preparation, administration, and plant parts used

Various methods were used to prepare herbal remedies. Decoctions (1,247 UR) were the predominant form of preparation found in this study, and they were mainly used for external applications such as baths, washes, and compresses, as well as for oral ingestion. This result is in line with the findings reported in neighbouring regions (Arévalo 1994). Elderly individuals favour decoctions when preparing remedies since they believe that steeping plant material in water for prolonged periods enhances its efficacy. Study participants shared various methods for preparing plant material, which included steeping fresh leaves in a large amount of cold water (771 responses), steeping ground, pounded, or grated leaves in a small amount of cold water (303 responses), and applying freshly squeezed leaf juice directly to the affected area (251 responses). All methods were deemed effective by the participants. Water forms the basis of almost all oral and topical treatments. Fresh plant material is used in the manufacture of remedies without exception. Two hundred and fifty-six UR (8.1% of the remedies) were prepared in *kawa* or "patarashca" form, a traditional Amazonian approach that involves wrapping small fish in *mani pui* leaves (*Calathea lutea* (Aubl.) Schult.) and lightly roasting them over a fire. The Cashinahua also use this method of preparation, slightly crushing the fresh leaves of medicinal plants and often adding the seeds of *maxe* "achiote" (*Bixa orellana* L.), mainly for the treatment of various skin and subcutaneous cellular tissue disorders, leishmaniosis, infections, inflammation, and injuries. The modes of preparation are presented in Table 6, listed in descending order of UR value.

Table 6. Modes of preparation

Mode of preparation	No. UR	% of total UR
Decoction	1,247	40%
Soaked in water	767	24%
Ground/pounded/grated	304	10%
Patarashca	257	8%
Squeezed	251	8%
Heated up	128	4%
Chewed	85	3%
Used whole	39	1%
Raw/unprocessed	27	1%
Infusion	17	1%
Exudate / leaf juice	1	0%

UR = Use Report. Modes of preparation listed in descending order of UR value (total of 3,163 UR).

It is worth highlighting that only 14% of the treatments were taken orally, whereas the overwhelming majority (85.9%) were administered externally, often through bathing solutions. Warm baths were the most commonly used method (762 UR) and, together with cold baths (89 UR), accounted for 32.7% of all external applications. Direct topical application accounted for 34.4%, followed by rubbing (15.1%) and washing (8.4%) of the affected area.

Oral administration consisted of 444 UR, including macerated potions of fresh plant material in water, which accounted for 64.6% of UR (287 UR), and decoctions, which accounted for 27% of UR (120 UR). Finally, only 1.1% of the recorded botanical material was used as a fumigant to combat infectious disease outbreaks and repel insects. This botanical material was predominantly leafy branches of *Couepia obovata* Ducke and *Ruizodendron ovale* (Ruiz & Pav.) R. E. Fr. in association with *Pityrogramma calomelanos* (L.) Link fern leaves. The different administration methods for herbal remedies are summarised in Table 7.

Table 7. Modes of administration

Mode of administration	Use Reports	% of total UR	Administration
Warm or cold bath	851	27%	external
Pressed on/in the affected part	715	22.7%	external
Friction (including whole fruit)	514	16.3%	external
Ingestion	444	14%	internal
Wash (including mouth wash)	235	7.6%	external
Eye drops	176	5.6%	external
Plaster	51	1.6%	external
Vaginal douche	48	1.5%	external
Burned/Fumigation	38	1.2%	external
Introduced in affected part	31	1%	external
Poultice	30	1%	external
Mouth wash	21	0.7%	external

UR = Use Report. Modes of administration are listed in descending order of UR value (total of 3,163 UR).

The direct application of either chewed or ground leaves, pressed on the affected area, was a frequently used method (22.7%) in the initial stage of treating venomous bites, as well as herpes leishmaniasis and cold sores. Fresh or heated leaves, crushed in a small amount of water, were commonly applied (16.2%) to areas experiencing inflammation, swelling, and pain, as well as a secondary treatment for snakebites or during pregnancy and childbirth. Washing the affected area (7.4%) was reported to alleviate rheumatic pain, headaches, abscesses, haemorrhoids, bleeding, and irregular menstruation, as well as to treat flu, diarrhoea, inflammatory conditions, and skin infections. Poultices and plasters (2.6%) made from crushed and mostly heated leaves were used to treat lumbago, facial paralysis, nervous tics, bruises, and closed wounds– and to prevent mastitis during weaning. Ocular administration - the instillation of crushed leaf juice directly into the eye (5.6%) - is a variation used by various Amazonian ethnic groups (Graham 2001; Luziatelli et al. 2010). The Cashinahua employ this method for the management of conjunctivitis, styes, visual impairments, and headaches. However, its most common usage involved an occurrence of fainting, dizziness, and intense convulsions (known as a *yuxin* attack), which healers compared to epilepsy. It was also utilised for culturally bound and magical purposes such as sorcery and "panema," which refers to misfortune in hunting. In addition, it was common to use it before hunting to improve vision in the shadows of the forest.

5.2.5. Cashinahua classification system in phytomedicine

The emic approach analyses local people's perceptions and categorisations of the world, their rules of behaviour, their subjective meanings, and the ways in which they imagine and explain events. Conversely, the etic approach, which is oriented towards scientists, scrutinises the anthropologist's observations, classifications, interpretations, and explanations as opposed to those of locals. The objective etic approach acknowledges that cultural insiders are frequently too immersed in their customs to provide impartial interpretations of their culture. By utilising the etic approach, the ethnographer underscores their own understanding of what is important. Etic and emic approaches were adopted in this study to compare different perspectives. The body systems were categorised etically according to Western concepts to facilitate data analysis, while an emic approach was adopted to attain an in-depth comprehension of the Cashinahua community's perspective on health and illness. The following part of the study uses the same approach.

This section provides an overview of the medicinal plant categories obtained by comparing the local names of the studied species and their translations. The analysis demonstrates that specific words commonly found in Cashinahua names of certain plants, including *bata*, *nenautsi*, *matsi*, *nuin*, *nixu*, etc., indicate distinct groups of plants as identified by plant specialists. Further research among the vegetalists participating in the study revealed that, in line with Cashinahua traditional medicine, there are categories of medicinal plants (*dau*) defined according to the range of health problems they are used to treat. Each of these categorisations has a central 'mother' or 'main' plant, which is the most significant species in its respective group and is generally combined with another plant from the same category when preparing a remedy. Six different classifications were identified through interviews with study participants and are presented in Table 8.

Table 8. Cashinahua classification of medicinal plants

Category	Healing qualities
Bata	snakebites or poisonous insect bites, universal remedies for all ailments
Nenautsi	infections, inflammation, swelling, tumours, hernia, pain relief, snakebite treatment, contraception and reproduction
Nixu	*yuxin* (or spirit) attack, animal transformation, fainting, loss of consciousness, cramps, convulsions, epilepsy, headache, lack of concentration and dizziness
Nuin	skin conditions, herpes, leishmaniasis, mycosis, shingles or *riwi*
Mecha	poisoning, viper bites, otitis, cuts, wounds, slit wounds
Matsi	inflammation

Bata group

This vital group of medicinal plants is used in the treatment of acute envenomation, including bites and stings caused primarily by poisonous reptiles, scorpions, stingrays, spiders, and insects such as isula, and is widely regarded as a panacea for all illnesses. The *bata* group is the most diverse, abundant, and important to the locals who live in this remote area, where the risk of snakebite is high because of the almost pristine rainforest environment. Although the 'mother' plant of the group is *besti bata - Rosenbergiodendron longiflorum* (Ruiz & Pav.) Fagerl from the Rubiaceae family, the most common plants within this category are members of the family Solanaceae (*utsi bata - Solanum mite* cf. Ruiz & Pav.*, kamuxun bata - Solanum oppositifolium* Ruiz & Pav, *kamuxun bata - Solanum thelopodium* Sendtn.*, xau bata - Solanum sessile* Ruiz & Pav., *texkan bata Lycianthes inaequilatera* (Rusby) Bitter and *bata hanaya - Lycianthes coffeifolia* Bitter) and the family Acanthaceae (*mikin medan putani bata - Pseuderanthemum lanceolatum* (Ruiz & Pav.) Wassh., *xuke bibex bata - Pseuderanthemum congestum* (S.Moore) Wassh., *dunu himi - Pseuderanthemum* sp.1, *matsi bedea - Herpetacanthus rotundatus* (Lindau) Bremek. and *xuke bibex bata pei ewapabu - Pulchranthus adenostachyus* (Lindau) V.M.Baum). Another important family is Salicaceae, with *Lunania parviflora* Spruce ex Benth. and different species of *Casearia* being the most used taxa.

According to traditional Cashinahua medicine, the treatment of snakebites, which can be fatal, involves three stages. Throughout the treatment, a strict diet is followed where the patient and the healer are prohibited from consuming cooked manioc (*Manihot esculenta*). Failure to adhere to the diet prevents the bite from healing and may cause chronic inflammation, resulting in lifelong lameness or disability. The selection of plants utilised in the initial stage depends on the type of snake responsible for the bite. A diverse range of 33 plant species can be employed as first aid for poisonous bites, some of which are specific to the species they treat, such as *kamuxun bata*, which is used to heal bites from a particular reptile species (*kamux* refers to "shushupe" or *Lachesis* sp.). Venomous snakebites can result in varying degrees of local and systemic effects, including shock and death. Some plants with the word "*dunu*" in their name, which refer to vipers of the *Bothrops* species (such as *dunu buxka nenautsi*, *dunu himi*, and *dunu nami mecha*), can be used to treat bites from species with haemotoxic and proteolytic venoms. Additionally, *besti bata* is considered a universal emergency remedy for both neurotoxic and haemotoxic venom.

To extract venom from the affected area, freshly crushed or chewed plant leaves are applied. The sap is then squeezed into the wound every 3-5 minutes until stool is passed by the patient, thereby signifying the removal of the venom. The initial stage of snakebite treatment involves administering emergency care to the injured site in a prompt manner.

The second stage of snakebite management commences following the expulsion of venom, entailing the immersion of the affected region in warm decoctions of *bata* plants, alone or in combination. This approach could be supplemented by the ingestion of small doses of the cooked remedy prepared for the bath, or by washing and rubbing the affected area with fresh leaves squeezed in cold water, in both cases at a frequency of 3-4 times a day. The ingestion of the decoction is sometimes administered in the second phase of treatment to lessen inflammation and hasten healing of the wound and surrounding tissue. The patient is instructed to remain recumbent and follow a specified diet during both initial phases of treatment. Once the aforementioned symptoms have subsided, the third stage of treatment can commence, wherein the body is strengthened and revitalised.

In the third and final stage of snakebite treatment, plants serve as a regenerative tonic, enabling the patient to recover strength and mobility. Until the third phase of treatment is completed, the patient should stay in their hammock and avoid standing up. In this stage of treatment, the plants are administered as warm and cold whole-body baths using a decoction of *dunun yubin*'s

Dracontium spruceanum (Schott) G.H.Zhu leaves and stems, *mai matsi – Cardiospermum halicacabum* L., and *utsi bata pei taxipa - Solanum mite* Ruiz & Pav. alone or in combination.

Nenautsi group

This group of medicinal plants is used to cure infections, inflammation, swelling, tumours, and hernia, as well as to soothe pain. They are also utilised in the second-stage treatment of snakebites, as a contraceptive, and to enhance fertility. The term *'nenautsi'* has an ambiguous meaning, referring to a process that can entail deflating, contracting, or drying. The meaning of nenautsi has been variously explained by the Cashinahua people themselves as "as if an umbrella closes" or "as if the ball deflates", while the most frequent explanation is "as when a coconut fruit dries". Vegetalists have compared the healing power of *nenautsi* plants to that of antibiotics. The 'mother' or 'head' of the *nenautsi* group comprises three distinct species unified by the Cashinahua denomination: *nenautsi himiya*. These species are *Rourea amazonica* Radlk., *Clitoria pozuzoensis* J.F.Macbr., and *Ormosia* sp. The Fabaceae family represents the prevailing taxonomic group in this category.

Nixu group

Medicinal plants is this group are used to cure possible medical conditions associated with possession, altered states of consciousness, or neurological disturbances including *yuxin* (or spirit) attack, animal transformation, fainting, loss of consciousness, cramps, convulsions, epilepsy, headache, lack of concentration, and dizziness. It is important to differentiate between these conditions and to explore the potential underlying causes, including psychological factors, social context, cultural beliefs, and medical issues. Objective evaluation and diagnosis are crucial for appropriate treatment and care, as well as for avoiding stigma, discrimination, or misinterpretation. A comprehensive and interdisciplinary approach is often necessary, involving medical, psychiatric, anthropological, and spiritual perspectives. The 'mother' or 'head' of the *nixu* group is *nixu pei dania* - *Crossopetalum parviflorum* (Hemsl.) Lundell. The families Acanthaceae, Aristolochiaceae, and Asteraceae are represented in this small group.

Nuin group

Medicinal plants in this group are used to cure skin affections, herpes, leishmaniasis, mycosis, dermatosis, eczema, abscesses, shingles, and "riwi". *Nuin* in the *Hantxa Kuin* language means earthworm or worm, and according to study participants this group of plants serves in a few words for all that itches. The plants of this broad *nuin* category are used to treat a variety of skin conditions, mostly prepared in the form of "patarashca" by squeezing warm juice on the affected area. The high diversity of plants used to treat various skin conditions and infectious diseases manifested on the skin shows the importance of this area of treatment. Skin conditions can be caused by a variety of factors, such as infections, inflammation, and allergies. These conditions can range from mild, such as acne and eczema, to more serious infections like herpes, leishmaniasis, and mycosis. Shingles is a viral infection that can cause a painful rash, and *riwi* is a skin condition that is endemic to certain areas in Amazonia. This diverse group with the 'mother' plant of *chudan nuin* - *Heliotropium funkiae* Feuillet is marked by a high representation of the Boraginaceae and Bignoniaceae families.

Mecha group

Medicinal plants in the *mecha* group are traditionally used to treat otitis media, cuts, wounds, and poisoning. In some cases, plants of this group are also used during the second phase of treatment for venomous bites, which is essentially treating the severe inflammation that has developed in the area of the wound. The 'mother' or 'main' plant of the *mecha* group is the *dunu nami mecha* plant - *Coussarea* sp.

Matsi group

This group consists of plants which are used by Cashinahua plant specialists to soothe and relieve inflammation. The term *'matsi'* signifies a cooling effect. Juicy leaves from plants belonging to the Begoniaceae and Gesneriaceae families, which are rich in sap, can be crushed and applied in cold water directly to the affected area. In instances where the inflammation is internal, the remedy can be applied to the skin above the affected area. Leaves from the 'mother' plant, *tetun pei matsi* (*Begonia maynensis* A.DC.), have been found to be a potent remedy for bronchitis and sore throat when pounded in fresh water and ingested (based on personal experience).

5.2.6. Cashinahua 'female plants'

The hypothesis that Cashinahua women possess extensive knowledge of medicinal plants used for treating reproductive health issues was confirmed by conducting extensive collaborative research with Cashinahua midwives. This research revealed that women have a deep understanding of plants that are used for addressing reproductive problems and family planning.

Through open interviews and semi-structured questionnaires, it was determined that 'female plants' are categorised into the groups outlined in Table 9. This classification was agreed upon by all participants in an objective manner. Further understanding of the categories was only possible with the input of the female participants. Indigenous communities have developed a broad range of practices and knowledge to reduce risks surrounding reproductive issues within the context of their culture, which values the importance of nature. Their beliefs hold that the violation of cultural norms can lead to illness. Therefore, women undergo various procedures during pregnancy to ensure a successful birth.

During field research conducted in 2013 and 2015, greater emphasis was placed on the study of gynaecological flora that Cashinahua women utilise during pregnancy to facilitate childbirth, offer postnatal care to the mother, and safeguard the infant during the initial months of life. Information about these plants could not be obtained from the male herbalists who were asked to present the plants used to treat illnesses as part of this research. They correctly argued that pregnancy and childbirth were not illnesses and therefore not addressed. Male healers discussed plants related to female reproductive system health solely for severe health problems and referred to plants used during pregnancy and childbirth as 'female plants'. Cashinahua women are knowledgeable about these species and their use. These plants cannot be categorised as exclusively gynaecological. Their usage is strongly intertwined with Cashinahua beliefs and worldview, which diverges from the Western perspective.

While working with women experienced in pregnancy care and childbirth, the participants classified the 'female plants' and the necessary dietary restrictions for parents during pregnancy, childbirth, and the initial months of a newborn's life into the categories presented in Table 9.

Table 9. 'Female plants' categories according to their uses

Category	**Therapeutic uses in individual categories**
bixtun epabu	To care for pregnancy and facilitate childbirth
haven nachix iti	To relieve pain and postpartum haemorrhage
bakeixta himi dachukiti	To "cleanse" the newborn's blood; protective baths
bakeixta nima tawakinan, eskawabinki taewakinan	To protect a mother and her child when they leave home together for the first time
dakati dau	For a child to detach from its mother and learn to sleep alone in its hammock
kuxipa dau	To enhance the physical fitness of children

Bixtun epabu category (mucilage plants)

Bixtun epabu is a group of plants used by Cashinahua women to treat pregnancy and ease childbirth. Upon being crushed in cold water, the leaves of *bixtun epabu* discharge mucus (*bixtun* - mucilage) that is utilised between the fourth and sixth months of pregnancy. Additionally, as part of their bathing routine in the river, pregnant women gently rub the lightly crushed leaves on their abdomen, legs, and genital area. In addition to the cold bath and rubbing, the woman also ingests a cup of the mucilaginous liquid extracted from the leaves of *bixtun epabu* plants, freshly prepared by soaking in cold water, which is believed to increase mucus in the abdomen. This is considered advantageous for aiding childbirth and ensuring the foetus grows healthy and strong. The leaves from a single plant within this category are generally administered once a week until labour begins. From the sixth month of pregnancy, expectant mothers begin taking *bin hexi* (*Guatteria* aff. *hirsuta* Ruiz & Pav.) to promote a clean and healthy birth for their baby, free from the presence of white mucus. A pregnant woman should take *mikin medan putani bata* (*Pseuderanthemum lanceolatum*) three times during her pregnancy, specifically during the seventh month and at the beginning and end of the eighth month. The purpose of this application is to maintain the baby's correct position by rubbing the stomach three times and consuming the plant's juice. Additionally, *chaxu bake bixtun* (*Tradescantia zanonia* and *T. zebrina*) is taken during the eighth month of pregnancy to promote swift labour and facilitate the release of the placenta and newborn.

As the expectant mother's due date approaches, her family attendant gathers 5 to 10 leaves (depending on their size) from each plant in the *bixtun epabu* group, which are found in the forest. The leaves are crushed in a medium-sized pot of cold water to massage the expectant mother's stomach when labour begins, and she consumes half a pot of the slimy liquid just before delivery. Most plants within this category are believed to promote labour and possess dilatation effects.

Pregnancy and childbirth are fundamental components of the human experience. This study delves into the women's social domain to gain insight into labour and delivery from a female perspective. Its objective is to demonstrate the Curanja River's Cashinahua women's perception, comprehension, and utilisation of plant remedies in prenatal care, childbirth support, and amelioration of neonatal distress. The plant remedies used for contraception and family planning are also documented in this part of the study. The initial pregnancy is crucial, a principle that also applies to Cashinahua women. A pregnant woman is prohibited from engaging in strenuous activities, carrying heavy loads, or travelling far from home. In the past, the first trimester of pregnancy was well regulated: from the third month, antenatal care begins, including the use of herbal remedies to aid childbirth and monitor the pregnancy. First, the pregnant woman commences treatment with the plants of the *bixtun epabu* group. She massages her abdomen with their leaves soaked in cold water during river bathing. Additionally, she consumes a small amount of the same remedy in the form of "agua de tiempo", a typical Amazonian means of administering remedies, instead of water when thirsty. First-time mothers also refrain from consuming certain foods during pregnancy due to food taboos. Throughout their pregnancy, they adhere to their dietary restrictions, which include avoiding the consumption of "male" meat from large animals and meat from animals that live in holes, such as majas (*Cuniculus paca*), achuni (*Nasua nasua*), and carachupa (*Didelphis* sp.), which are typically killed with smoke, as well as hole-dwelling carachama fish (*Pseudorinelepis* sp.), stingrays, and water turtles. According to the principle of similarity, it is believed that consuming an animal that dies in a hole will prevent a child from being born alive. Mothers who have had multiple children no longer adhere to a special diet as they have become accustomed to the process of childbirth. They already "know how to give birth". If the foetus is in a breech position during the eighth month of pregnancy, the expectant mother can try to adjust the baby's position herself. This can be done by applying peanut oil to the stomach in the morning when the baby is most still.

Most Cashinahua women give birth at home in an upright, squatting position, using their hammock under their armpits for support. If necessary, an experienced woman from the expectant mother’s family or the expectant mother's husband can assist by placing their hands under her shoulders from behind. The assisting woman then places a towel on the floor under the expectant mother and supports her by spreading her legs. Finally, she uses another cloth to hold the newborn baby. The umbilical cord is cut to the length of three fingers with scissors, the blood is drained from the umbilical cord, and the navel is tied with a new cotton string. The umbilical cord is cut by the woman who helps the new mother give birth. She may come from another family, but she is always an experienced birth attendant. Following this, the attendant bathes the newborn in warm boiled water, swaddles the infant in a clean towel, and places it to rest at its mother's breast or in her hammock. Afterward, the baby is bathed daily with warm, boiled water.

If the child is born with a fever, it is cured with *xixibin* seeds (*Sesamum indicum* L.). This plant does not grow wild in Purus but was introduced from Brazil by relatives and was found in the home gardens of all the participating communities. The *xixibin* plant produces many seeds when sown by mixing the seeds with sand and dried chicken and cow dung. It is a powerful remedy and is highly respected by the Cashinahua, who always keep dried *xixibin* seeds in their homes as an emergency remedy for any serious or persistent illness that cannot be cured by other medicines, such as fever, headache, or bloody diarrhoea. *Xixibin* seeds are also used to cleanse the newborn baby's body.

If labour occurs at night and the plants of the *bixtun epabu* group cannot be found in the forest, only mallow leaves (*Malachra* spp.) and *xixibin* seeds can be used to facilitate childbirth. The 'female plants' are used to prevent discomfort in pregnant women, correct breech presentation and transverse position of the foetus, relieve pain during labour, improve dilatation, and speed up delivery. In the postpartum period, they are used to wash the genital area, stop bleeding, promote placental expulsion and uterine inversion, relieve postpartum discomfort, and help the new mother recover.

Haven nachix iti category

Haven nachix iti or *himi dachukiti* (*himi* = sangre) is another category of plant used to relieve postpartum issues. The day following childbirth, the plants of the *haven nachix iti* category can be used to relieve pain in the mother's body and postpartum bleeding. Plants of this group are never used with cold water, instead they should always be prepared and applied with warm or hot water, and they are not suitable for washing the whole body. The medicinal preparations derived from this plant group are exclusively intended for application to the lower abdomen and genital area of the mother postpartum. It is believed that the remedy prepared from these plants, if applied to the breasts, would stop milk production, and consequently impede breastfeeding. In tropical rural areas, the use of water and fire is crucial for housewives. According to Cashinahua tradition, a new mother must avoid contact with cold water and fire for at least one month after delivery to protect her child's health. This is a vital aspect of the system of restrictions and cultural taboos that both parents must follow during the first month of their child's life to ensure their safety. In order to work with water and fire, which are essential elements for the daily needs of Cashinahua women, the mother will bathe several times with a decoction of *chi bata*, derived from the leaves of *Bouchea fluminensis* (Vell.) Moldenke. Both male and female respondents agreed that *chi bata* is used exclusively for this purpose, highlighting the significant socio-cultural importance of this plant. This is a part of the system of restrictions that both parents must adhere to for the first month of their child's life to ensure protection. The mother shall abstain from sex for the first two months after giving birth. Disobedience of this rule leads to their child becoming ill, which will result in constant crying and sleeplessness.

Bakeixta himi dachukiti category

A selection of plants is utilised to ready infants for their initial outing with their mother outside of the home. Typically, it is not until a baby reaches the age of three or four months that it can leave the house for the first time. The first journey commonly revolves around visiting the mother's chacra or meeting relatives in a different community. Prior to embarking on extended voyages or venturing far from home, a baby must be suitably treated with *kuman maxu Clitoria* sp. *Kuma* (shihuahuaco) *Dipteryx micrantha* Harms is an emergent tree that can reach heights exceeding 50 m, rendering it one of the tallest trees in the jungle. It is believed to possess a "mother" or *yuxin*, a powerful spirit that can impact a child if left untreated, causing symptoms such as fainting, dizziness, and vomiting. Parents must exercise deference towards this spirit and take precautions to protect their child. The child can be cured with *kuman maxu* and *buni maxu*, allowing them to travel afar. Furthermore, the child is bathed with *bai xaba Chromolaena laevigata* (Lam.) R.M.King & H.Rob. to "guard its path".

Dakati dau category

When a baby reaches three to four months old, it seeks the presence of its parents and refuses to sleep alone in a hammock and will not stop crying. Cashinahua women hold the belief that unless treated with *dakati dau* plants, the baby will persistently cry and cling to its mother. Thus, they wash the baby in a mixture of calming plants in this category, so that it can sleep alone in its hammock.

Kuxipa dau category

This group consists of plants used for enhancing a child's physical health. From the seventh or eighth month of a child's life, it could learn to walk with the assistance of the leaves of this plant group. Administering a plant from the *kuxipa dau* category enables a child to walk independently by the eighth month. To improve a child's physical health from the second month of life until the age of one, parents should bathe the child in a warm decoction of *kuxipa* plants in combination. *Yawan kuxi dau - Aphelandra lasiandra* (Mildbr.) McDade & E. Tripp is cited by Graham (2001) for identical purposes.

5.3. The most important ailment categories and their treatments

5.3.1. Snakebites

The majority of uses in our study represent envenomation (311 UR), resulting particularly from snakebites as well as stings and bites from other venomous animals, including scorpions and spiders. Plants for treating snakebites were always the first to be mentioned by the research participants and are considered the most culturally important.

From the 467 medicinal species collected, Table A1 (Appendix 1) shows that for the treatment of snakebites, the most cited species are *Casearia obovalis* Poepp. ex Griseb. and *Solanum thelopodium* Sendtn. with 15 UR each, followed by *Leonia glycycarpa* Ruiz & Pav. and *Mascagnia eggersiana* (Nied.) W.R.Anderson with 13 UR, and then *Rosenbergiodendron longiflorum* (Ruiz & Pav.) Fagerl. and *Solanum sessile* Ruiz & Pav. with 11 use reports (UR). *Aegiphila cuneata* Moldenke, *Casearia* sp.3, and *Lunania parviflora* Spruce ex Benth. each have 10 UR. Three additional species that study participants often mentioned for treating snakebites include *Caamembeca spectabilis* (DC.) J.F.B. Pastore, *Dracontium loretense* K.Krause, and *Pseuderanthemum* sp.3. The three most frequently employed plant genera for treating venomous snakebites across all three stages of treatment are *Solanum*, with 32 UR and 3 species, *Casearia*, with 30 UR and 4 species, and *Pseuderanthemum*, with 19 UR and 5 species.

5.3.2. Infections and infestations

In this investigation, the second most frequently mentioned ailment category was infections and infestations, which showed 291 UR. This category comprised a range of conditions, including herpes, leishmaniasis, conjunctivitis, and general infections. In this group, *Pseuderanthemum congestum* (S.Moore) Wassh. had the highest number of URs with 13, followed by *Esenbeckia febrifuga* (A.St.-Hil.) A.Juss. ex Mart. with 12 UR, *Pseuderanthemum lanceolatum* with 11 UR, and *Drymonia tenuis* (Benth.) J.L.Clark and *Piper leucophaeum* with 10 UR each. The Pan American Health Organization points out that leishmaniasis is among the top 10 neglected tropical diseases, with more than 12 million people infected globally. Our research findings demonstrate that the leaves of *Jacaranda glabra* (DC.) Bureau & K.Schum. were used in the treatment of advanced states of leishmaniasis, accounting for 8 UR. Strong anti-herpetic activity is attributed to 21 species, including *Pseuderanthemum congestum*, *P. lanceolatum*, *Caamembeca gigantea* (Chodat) J.F.B. Pastore, and *C. spectabilis* (DC.) J.F.B. Pastore, which are the most mentioned.

5.3.3. Pregnancy and birth disorders

An inseparable part of human life is pregnancy and childbirth. The frequency of hospitalisations related to pregnancy, childbirth, and the postpartum period in the Ucayali region supports the significance of this category, which ranks fourth in this study but has the highest ICF value (0.80). This underscores the importance of comprehending the diverse range of plants accessible to Cashinahua women to manage this significant life event. The family Malvaceae predominates in terms of frequency of use, with seven different species recorded as having 77 different uses, confirming the knowledge and expertise of the Cashinahua women, who claim that the mucilaginous leaves of certain plants hold the greatest potency in preparing for and supporting childbirth. The species that were most frequently cited, listed in order of documented usage frequency, are the leaves of *Quararibea wittii* K.Schum. & Ulbr. and *Theobroma cacao* L. both with 19 UR, and *Matisia cordata* Bonpl. with 14 reported uses. The following species on the list include *Abutilon* sp.1 and sp.2, *Malachra alceifolia* Jacq., and *Pavonia fruticosa* (Mill.) Fawc. & Rendle. In addition, two species of the Commelinaceae family are represented in *Tradescantia zanonia* (L.) Sw. with 20 UR and *T. zebrina* Bosse with 9 UR. To clarify, UR refers to the number of occurrence records for each species. Acanthaceae is another family that is widely represented, with a total of 26 UR. *Pseuderanthemum lanceolatum* (Ruiz & Pav.) Wassh. was referenced the most frequently, appearing in 18 UR, followed by *Pseuderanthemum* sp.3, *Dianthera pectoralis* (Jacq.) J.F.Gmel., and *Stenostephanus* sp. in descending order. *Piper reticulatum* L. with 23 UR is undoubtedly the most commonly used plant to support pregnancy and ease childbirth, and it is the only member of the Piperaceae family used for these purposes. Another significant species for managing pregnancy, inducing labour, and treating postpartum disorders is *Acalypha diversifolia* Jacq. (9 UR) from the Euphorbiaceae family.

5.4. Scientifically neglected medicinal plants

The study revealed that the Cashinahua use several overlooked medicinal plants. A comparison of the 467 documented species with the scientific literature revealed 79 species that are not currently listed in the WOS database as medicinal or ethnobotanically used, nor analysed for biologically active compounds. The distribution of species with little or no pharmacological documentation is spread among 60 genera and 42 botanical families. Acanthaceae serves as the most represented family with seven species, followed by Fabaceae, Araceae, and Solanaceae. Notably, there are 172 uses for the 79 new or little-known medicinal plant species. Table A2 (Appendix 2) presents these taxa in alphabetical order according to species and their use in Cashinahua herbal medicine.

Among these 79 underreported species, the most frequently recorded therapeutic activities involved pregnancy and birth disorders (13.84%), followed by poisonings, and infections and infestations. A wide variety of applications characterise a few species, and five of them stand out because of their adaptability: *Aphelandra lasiandra* (Mildbr.) McDade & E.A.Tripp., *Rourea amazonica* (Baker) Radlk., *Adiantum poeppigianum* C. Presl, *Begonia maynensis* A. DC., and *Leonia glycycarpa* Ruiz & Pav. The predominant application form was external (87%). In Table A2, taxa with a frequency of citation (FC) higher than ten are marked with an asterisk. Most of the species cited have multiple medicinal uses.

The selection of species for specific disease categories was based on the number of citations they have received. Table 10 presents the species that were cited over 14 times for a particular use. These species are regarded as suitable for phytochemical analysis to confirm their efficacy.

Almost a quarter of the uses of species with the highest frequency of citations (FC) listed in Table 10 are related to the treatment of snakebites, thus providing further evidence of the importance of plants in the treatment of this life-threatening condition.

Table 10. The neglected species used for particular ailments based on the highest FC

Plant species	**Uses**	**FC‡ (n=20)**
Machaerium cuspidatum Kuhlm. & Hoehne	Open wounds, cuts	20
Solanum sessile Ruiz & Pav.	Snakebites	20
Tradescantia zanonia (L.) Sw.	Labour induction	20
Mascagnia eggersiana (Nied.) W.R.Anderson	Snakebites – *shanu*	19
Bomarea edulis (Tussac) Herb.	Facial paralysis	18
Guazuma crinita Mart.	Behaviour disturbances	18
Rosenbergiodendron longiflorum (Ruiz & Pav.) Fagerl.	Snakebites	17
Philodendron ernestii Engl.	Nervous tic	16
Urceolina cyaneosperma (Meerow) Christenh. & Byng	Labour induction	16
Centropogon cornutus (L.) Druce	Canker sores	15
Cuspidaria floribunda (DC). A. H.	Herpes zoster	15
Neea divaricata Poepp. & Endl.	Bleeding	15
Solanum thelopodium Sendtn.	Snakebites - *kamux*	15
Aphelandra acrensis Lindau	Facial palsy	14
Aphelandra lasiandra (Mildbr.)	Seizures, epilepsy	14
Connarus punctatus Planch.	Conjunctivitis	14
Drymonia coccinea (Aubl.) Wiehler	Inflammation of the testicle	14
Leonia glycycarpa Ruiz & Pav.	Snakebites - *shanu, kamux*	14
Matisia cordata Bonpl.	Labour induction	14

FC = Frequency of citation.

5.5. Comparison of medicinal plants used among different ethnic groups in the region

The medicinal plants in the study region were compared to appropriate ethnobotanical studies from the Peruvian Amazon and neighbouring areas of Brazil and Bolivia, specifically including research by Alexiades (1999), Sanz-Biset et al. (2009), and Odonne et al. (2013). A Venn diagram illustrating the overlap between this study and other Amazonian ethnic groups is presented in Figure 11, while Table 11 displays the Jaccard similarity indices.

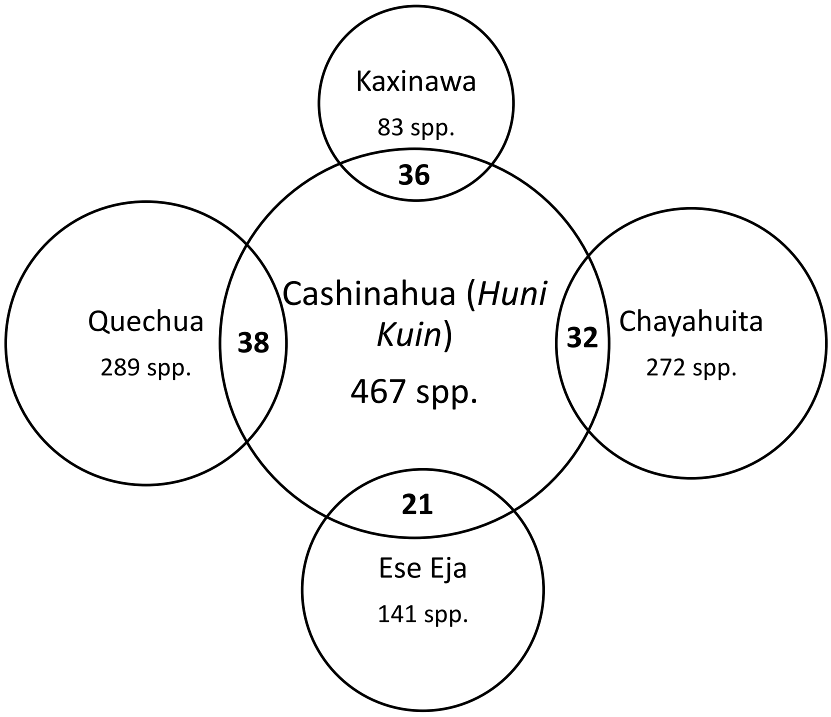


Figure 11. Venn diagram comparing the number of medicinal plant taxa documented in the present study and studies of other Amazonian ethnic groups.

It is unsurprising that there exists a great resemblance at the genus and species level with regard to the herbal remedies utilised by the Brazilian Kaxinawa (Huni Kuĩ), residing in the Jordão River region of the neighbouring Acre state. Although fewer botanical taxa were recorded, similarities with areas in different parts of the Peruvian Amazon were noted. The traditional medicines of the Ese Eja community, who live on the shores of the Heath River which forms the border between Bolivia and Peru, showed the least resemblance.

Table 11. Ethno-geographical comparison of medicinal plant species used in the region

Region and administrative department	Ethnic group	No. of genera	No. of species	No. of identical genera	No. of identical species	Jaccard Index (genera)	Jaccard Index (species)	Reference
Brazilian Amazon Jordão River, State Acre	*Kaxinawa* (*Huni Kuĩ*)	72	83	56	36	20.82	8.89	Penedo *et al.* 2023
Peruvian Amazon Chazuta Valley, San Martín	*Quechua (Lamas Quechuas)*	202	289	92	38	25.34	6.24	Sans-Bizet *et al.* 2008
Peruvian Amazon Paranapura Basin, Loreto	*Chayahuita (Shawi)*	191	215	74	32	20	5.91	Odonne *et al.* 2013
Bolivian Amazon, La Paz **Peruvian Amazon**, Madre de Dios	*Ese Eja (Huarayo)*	123	129	46	21	13.93	4.51	Alexiades 1999
Peruvian Amazon Curanja River, Ucayali	*Cashinahua (Huni Kuin)*	253	358	N/A	N/A	N/A	N/A	The present study

The largest number of medicinal species used has been documented in the Alto Purus River basin (Department of Ucayali and State of Acre) with 411 species (this study and de Almeida et al. 2023), followed by the Chazuta Valley (Department of San Martín) with 289 species (Sanz-Biset et al. 2009), the Paranapura basin (Department of Loreto) with 215 species (Odonne et al. 2013), and the Heath River basin in the Peruvian Department of Madre de Dios and the neighbouring Bolivian Department of La Paz with 129 species (Alexiades 1999). The only taxon that is common to all of the compared studies is *Petiveria alliacea* L. The following are medicinal species that were recorded in three of the four studies: *Abuta grandifolia* (Mart.) Sandwith, *Banisteriopsis caapi* (Spruce ex Griseb.) C.V.Morton, *Bixa orellana* L., *Calycophyllum spruceanum* (Benth.) K.Schum., *Dracontium spruceanum* (Schott) G.H.Zhu, and *Mansoa alliacea* (Lam.) A.H.Gentry.

5.5.1. Overlapping uses of medicinal plants by different ethnic groups

Comparison of available data illustrated the distinctiveness of the Cashinahua use of medicinal plants in comparison to other ethnic groups in the area. The Cashinahua employed a wider range of taxa, including a significant number of plants that were not utilised by other tribes. This uniqueness can possibly be attributed to the exclusive botanical environment of the research site, which is remarkably preserved due to the sparse population and accessibility challenges. Species that overlap and are used by several ethnic groups in the study (with only one species, *Petiveria* *alliacea*, widely known and used by different ethnic groups, and referred to as mucura by the mestizo population) are common, and most of them were traditionally collected and sold at medicinal herb markets. When comparing research results, it is imperative to consider the number of study participants, duration and scope of the research conducted, and accordingly the number of medicinal plants documented. These factors significantly impact the resulting number of botanical samples and the related information.

This study compares the medicinal plant use of the Cashinahua with that of four neighbouring ethnic groups. Of the 467 documented plants recorded in this study, 73 species were found to be consistent with one of the four ethnic groups compared. For instance, for the Ese Eja ethnic group, the use of plants to treat a specific health problem was congruent for 12 of the 141 species presented by Alexiades (1999), for the Chayahuita, 10 uses were consistent out of 272 documented species (Odonne et al. 2013), and for the Quechua of the Chazuta Valley, 8 congruent uses were found out of 289 medicinal species recorded in the work of Sans-Bizet et al. (2009). Compared to the Brazilian branch of Kaxinawa, 36 out of the 83 documented species were identical. However, only 5 of these species had identical uses (de Almeida et al. 2023a). When compared to the IIAP database, which is the only available database of over 1000 Peruvian medicinal species from the Peruvian Amazon, this study found 33 medicinal uses that were identical. Table A3 provides a detailed comparison of identical medicinal uses. It can be found as Appendix 3 in the Supplementary Material.

5.6. The emic approach: perceptions of community members

As part of the ethnobotanical investigation, 33 female and 35 male respondents from 68 Cashinahua households were interviewed in-depth. The aim was to gather data about their demographics, familial illnesses from the past year, treatments received, and herbal remedies available in their homes. Participants from four out of the five communities examined responded to the household questionnaire. In 2015, cooperation was not obtained from the indigenous community of El Triunfo, as the village was abandoned and its inhabitants moved to Brazil after a tribe in voluntary isolation attacked the community. The semi-structured household interviews investigated the treatment alternatives available for ailments and injuries, which included self-medication, consulting a medical expert or traditional herbalist, and the medicinal plants that households stored at home, in the garden, or close by for urgent need. Another question posed to study participants involved illnesses that had affected their household over the last year, as well as the treatments used to remedy them and the perceived origins of the ailments. The Cashinahua identified a range of symptoms that were open to multiple interpretations, depending on their age, education, and social circumstances. Notably, social context played a significant role in symptom recognition and understanding of the underlying causes, which is illustrated through the examples presented in Table 12.

Table 12. Prevalent diseases within the four communities studied

Disease	Frequency of citation	Percentage of respondents	Symptoms	Perceived causes	Plants and their mixtures used for treatment
Influenza	26	38.2 %	Headache and body aches Fever	Getting wet or working in the sun Going out in the sun and rain Due to carelessness	*maka huni, xawan nea, buna bata. chaki*, Mixtures: *kuin xia, du hina, xixi itsa kabia, yuxinin yuchi.* *awa punu nenautsi, nenautsi, muka, bedudu.* *nawa maxkini*
Cold	17	25 %	Sore throat Fever Stuffy nose	Sun/rain Cold weather "Mal aire" (bad air) Contaminated environment	*buna bata, awa punu nenautsi, nenautsi, muka, bedudu, xia, badin pakex matsi, bushudi, maka huni, madi chibudux.* Mixture*: taku dexni, yuna dau, mauha.*
Fever	15	22.1 %	Fever with headache and body aches, cold Vomiting Patient thinks he/she is going to die	Getting wet or working in the sun Going out in the sun and rain "Daño", can die if it is not healed by a healer	*xawan nea.* *yapa mexupa pei, awa huinti, chaki, badin pakex matsi, dau pei taxipa xan ika maxe, akukabia bai nemakia. kuin xia.*
Pain	14	20.6 %	Body aches, joint pain	Hard work	*hasin punu nenautsi. dunti puyan, nenautsi.* Mixture: *awa punu nena utsi, hasin punu nena utsi, punu chiwa, baniman aka dau, kapa xeta nena utsi.*
Headache	9	13.2 %	Headache, dizziness	Concerns about some distant relatives Sunstroke Thinking a lot	*mae xekeake.* Mixture: *maka huni, xinu inin, isun bunkax, dunu shepu, hanpis dau nixi, badin pakex, dei yuxibu bixtu, baxawa kabia.*
Cough/ bronchitis	8	11.8 %	Sore throat and chest pain	Rain "Mal aire" (bad air)	*buna bata.* *uku dau, awa huinti, muka, pisi. bixtun epa huxupa*
Diarrhoea	6	8.8 %	Stomach and back pain Nausea, vomiting	Bad or contaminated food Severe sunstroke After thinking a lot about relatives Poor diet and lack of hygiene Sailing up the river without eating	*baniman aka dau, bunpa.* Mixture*: maka huni, xinu inin, isun bunkax, dunu xepu, hanpis dau nishi, badin pakex, dei yuxibu bixtu, baxawa kabia.*

Table 12. Continued

Disease	Frequency of citation	Percentage of respondents	Symptoms	Perceived causes	Plants and their mixtures used for treatment
Gastritis	4	5.9 %	Stomach pain, back pain Burning stomach, muscle pain, nausea	Eating spicy food Eating beef Eating fatty meals	*anun buna dau.* *bakachi pei, kada jiuda pei, midis.*
Hernia	4	5.9 %	Severe black diarrhoea	Carrying weight	*maspanewan.* *xipin tun akai bata, mae muxa.*
Fainting	3	4.4 %	Fainting, nausea, dizziness Unconsciousness, vertigo Severe headache, diarrhoea	Fishing far away from the community May be due to "daño" Spirit attack	*hane bata, xixi itsa*
Haemorrhage	2	2.9 %	Abdominal bleeding, fever		*kuin xia, himi kains.*
Abscess	1	1.5 %	Inflammation,	Insect bites	*yawa tsis nuin.*
Injury	1	1.5 %	Swollen, black bruising, severe pain, cannot walk	Falling in the boat	*txaxu nami nuin, awa pununenautsi, kespin xanichi.*
Kidney inflammation	1	1.5 %	Painful urination, muscle pain	During pregnancy	*txaxu nami nuin*
Ovarian infection	1	1.5 %	Pain and bleeding	Not dieting after giving birth	*aku kabia, himi kudu bunpa, paico*
Rheumatism	1	1.5 %	Knee and leg pain	Walking a lot	*hasin punu nenautsi*
Swelling	1	1.5 %	Pain, severe fever	Bite of *dunu xena* - venomous lizard	*xuke bibex bata*
Toothache	1	1.5 %	Severe toothache, swelling	After eating hard food	*kuin xia*
Tuberculosis	1	1.5 %	Dry cough, coughing up blood, chest pain	Lack of food, congestion	Health centre Esperanza

Knowledge of the presence of medicinal plants and their uses in the vicinity of the interviewees' homes highlights the significance of addressing the aforementioned prevalent health issues. Table 13 provides a breakdown of the primary applications of these medicinal plants, with rankings based on their levels of usage (UR). The household questionnaires generated a total of 338 UR. Some participants disclosed multiple plants used for a particular ailment. The most frequently cited conditions included headaches, fever, coughing/bronchitis, fainting, diarrhoea, inflammation, spirit or *yuxin* attacks, and the challenge of soothing crying infants during the night. It is noteworthy that the Cashinahua community places great emphasis on mitigating the disruptive impact of crying babies, especially considering the village's size and the potential for a solitary crying infant to disrupt the rest of the community. Inconsolable crying is frequently attributed to malevolent spirits rather than physiological discomfort. During the study, 73 use reports (UR) were recorded regarding the calming of a child experiencing a nightmare, demonstrating the significance of this issue for the community. The most frequently reported species was *Piper aduncum* with 18 UR, used for vomiting, headaches, and fainting, followed by *Chromolaena laevigata* with 12 UR, used for the treatment of leishmaniasis, calming a crying child, and protection.

Table 13. Predominant uses of wild medicinal plants in the vicinity of the community

Medical condition	UR_1	Species	UR	NS
Fainting	21	*Piper aduncum* L.	5	14
Vomiting	19	*Piper aduncum* L.	9	8
Headache	18	*Fridericia japurensis* (DC.) L.G.Lohmann *Piper aduncum* L.	4 4	14
Snakebites	18	*Caamembeca gigantea* (Chodat) J.F.B.Pastore	6	13
Diarrhoea	15	*Hilleria secunda* (Ruiz & Pav.) Kuntze *yukan mawan* not collected	4 4	11
Spirit attack	13	*Dolichandra unguis-cati* (L.) L.G.Lohmann	3	8
Calm crying baby	9	*Chromolaena laevigata* (Lam.) R.M.King & H.Rob.	3	4
Leishmaniosis	9	*Chromolaena laevigata* (Lam.) R.M.King & H.Rob.	7	3
Scabs in scalp	9	*Lantana camara* L.	9	1
After childbirth*	8	*Bouchea fluminensis* (Vell.) Moldenke	8	1
Hunting	8	*Piper laevigatum* Kunth	6	3
Pain	8	*Fairchildia* sp. *muka* not collected	2 2	8
Protection	7	*Chromolaena laevigata* (Lam.) R.M.King & H.Rob. *katsa dau* not collected	2 2	5
Cold sores	6	*Pseuderanthemum congestum* (S. Moore) Wassh.	2	5
Cough	6	*bixtun epabu* not collected	6	8
Dizziness	6	*Justicia aphelandroides* (Mildbr.) Wassh	3	6
Epilepsy	6	*Strychnos brachiata* Ruiz & Pav.	3	3
Haemorrhage	6	*Fridericia florida* (DC.) L.G. Lohmann	5	2
Pregnancy care	6	*Nectandra* sp. *Piper reticulatum* L.	2 2	4

A total of 338 UR was reported for 68 respondents. The medical conditions are presented in descending order of UR_1. UR_2 represents the number of use reports referenced for that particular medicinal condition. NS = Number of species used for a specific health condition.

**Bouchea fluminensis* (Vell.) Moldenke or *chi bata* holds significant socio-cultural meaning, as unanimously agreed upon by all respondents. According to tradition, mothers of newborn infants are forbidden from touching cold water and working with fire for a specified period to avoid causing harm to their child. Failure to adhere to this taboo is considered a breach of custom. Taking a bath in a decoction of leaves called *chi bata* is believed to provide protection to both the mother and newborn baby. It also enables the mother to subsequently cook over a fire and bathe in the river.

One of the questions asked during the household interviews concerned the plants grown in the respondents' gardens and their main uses (Table 14). It can be inferred that the presence of medicinal plants grown near dwellings indicates their frequent use and therefore their importance to the household.

Table 14. Predominant uses of common and easily accessible medicinal plants

Medical condition	**UR**	**Species** (vernacular name if not collected)	**UR**	**Number of species**
Headache	24	*buxka isin dau,* not collected	7	6
Fever	15	**Coleus amboinicus* Lour.	7	3
Cough/bronchitis	13	*Coleus barbatus* (Andrews) Benth. ex G.Don	5	5
Fainting	12	*Brunfelsia grandiflora* D.Don	4	7
Diarrhoea	11	*bunpa,* not collected	3	8
Inflammation	11	*Senna hirsuta* (L.) H.S.Irwin & Barneby	8	3
Calm crying baby	10	*Peperomia pilosa* Ruiz & Pav. *Tanaecium dichotomum* Jacq.) Kaehler & L. G. Lohmann	4 4	4
Wounds/cuts	8	*muka,* 3, not collected	3	6
Dizziness	7	4, *Drymonia teuscheri* (Raymond) J.L.Clark	4	4
Pain	7	3, *Brunfelsia grandiflora* D.Don	3	5
Peaceful sleep	6	6, *Peperomia pilosa* Ruiz & Pav.	6	1
Sore throat	4	*pisi xaka dau*, 4, not collected	4	4
Skin conditions	3	2, *Cuspidaria floribunda* (DC.) A.H.Gentry	2	2
Toothache	3	3, *Bunchosia* sp.	3	3
Vomiting	3	*Brunfelsia grandiflora* D.Don *Piper aduncum* L., *Cantinoa althaeifolia* (Pohl ex Benth.) Harley & J.F.B.Pastore	1 1 1	3
Blennorrhagia	2	2, *Arrabidaea* sp.3	2	1
Cold sores	2	*Pseuderanthemum congestum (S. Moore) Wassh.* *Pseuderanthemum lanceolatum* (Ruiz & Pav.) Wassh.	1 1	2
Fishing	2	*pakadim, pesmin,* not collected	1	2

Total of 181 UR were referenced by 68 respondents. Some of the respondents of household questionnaires referenced more than one plant for a similar medical condition.

**Coleus amboinicus* and *C. barbatus* are species introduced from Africa, which were obtained through exchange with relatives living on the Brazilian side of the border (personal communication). It is surprising to find these plants in such a remote area, as *C. barbatus* is not found on the American continent, according to the recorded distribution in the POWO database. It should be emphasised that this research involved ordinary villagers, in contrast to the previous section where medicinal plants and their uses were presented by plant specialists. Thus, these findings represent the general understanding and application of medicinal plants by members of the community.

Respondents of the household questionnaire were asked about their preferred sources of treatment for an ailment, including self-medication, local healers, medical professionals in nearby towns, or other alternative methods. Table 15 presents the available healthcare options and their preference in the community.

Table 15. Informants' prioritised type of healthcare in the event of illness or injury

Contact points in the event of illness	**No. of respondents (n=68)**	**% of respondents**	**Age span**	**Respondents average age**
Herbalist in the community	40	58.8 %	15 – 79 years	42.9
1/ Self-medication: pills (health promoter) 2/ Vegetalist in the community	9	13.2 %	22 – 62 years	35.1
1/ Doctor in a health centre 2/ Vegetalist in the community	8	11.8 %	19 – 67 years	35.6
1/ Vegetalist in the community 2/ Self-medication: conventional medicine (health promoter)	4	5.9 %	30 – 57 years	49
Doctor in a health centre	3	4.4 %	23 – 44 years	32
Self-medication: conventional medicine (health promoter)	3	4.4 %	21 – 35 years	28.7
1/ Vegetalist in the community 2/ Doctor in a health centre	1	1.5 %	65	65

Of the 68 participants, 40 indicated a preference for consulting a community herbalist in the event of illness or injury, representing 58.8% of respondents. The mean age of those who expressed interest in seeking conventional treatment was 42.9 years, with age ranging from 15 to 79 years.

Of the respondents, nine (13.2%) elected to self-administer standard medication through the community health promoter, with the option to consult an herbalist if the initial treatment was ineffective. The average age of this group was 35.1 years. Another eight participants (11.8%), with a mean age of 35.6 years, chose to travel to a medical centre in Puerto Esperanza, a two-day journey away, and then seek advice from an herbalist. Four participants stated that they would first consult an herbalist from their community for any health problems and then seek assistance from the health promoter for medication if necessary. Three respondents (with an average age of 32 years) would visit a doctor in Puerto Esperanza. The remaining three respondents, averaging 28.7 years of age, expressed their intention to seek help from a community health promoter.

Nearly 60 participants expressed a preference for having access to a plant specialist within their community in the event of sickness or injury, highlighting the prevailing significance of traditional plant medicine in these isolated areas. The survey also identified individuals acknowledged by each community as possessing the most extensive knowledge of medicinal plants and their applications. These findings correspond with the chosen participants of this investigation.

6. Discussion

6.1. Medicinal plant knowledge of the Cashinahua

The knowledge of plant specialists covers the traditional uses of plants, while the general population in the study areas shares information about the available plant-based remedies for minor injuries and common illnesses. The hypothesis proposing that the Cashinahua employ a multitude of medicinal plant species for treating a wide spectrum of health disorders is supported by the recorded use of 467 different species with 3,164 different uses.

As previously stated, Graham (2001) conducted an earlier study on the medicinal flora employed by the Cashinahua community situated in the vicinity of Colombiana village. Therefore, this section compares the plant uses of specific significant species that were common to both Graham's research and the present study, as well as with the literature reported in the WOS and other available sources.

Differences exist between this study and Graham's research in terms of the representation of species within botanical families. The family Acanthaceae has the highest number of documented species in this research, followed by Piperaceae, Rubiaceae, Araceae, Fabaceae, and Bignoniaceae. In contrast, Graham's study found the family Rubiaceae to be the most numerous, followed by Acanthaceae, Solanaceae, Piperaceae, Araceae, and Asteraceae. It is worth noting that this disparity could be attributed to varying fieldwork methodologies. Graham carried out his research with one recognised Cashinahua plant specialist near the village of Colombiana, while the present study was conducted in five Cashinahua villages along the upper course of the Curanja River. In each community, two respected herbalists participated, followed by two experienced midwives, for a total of 20 participants. Another difference was that during the extensive biodiversity survey of Purus Province, Graham and his team collected approximately one thousand samples of non-cultivated plants, with around 75% of them having some practical use. Of the useful plants, roughly 70% were utilised in Cashinahua traditional medicine (Graham 2001; Pitman et al. 2003). The method of plant sampling utilised in the current inventory involved solely the collection of medicinal plants encountered during fieldwork with research participants, and the plants were identified accordingly.

Of the 110 plants presented in Graham's doctoral thesis, only 34 of them correspond to the 467 species reported in this study, suggesting a 60% discrepancy in the species recorded. This illustrates the Cashinahua's extensive knowledge of the therapeutic qualities of the flora in their natural habitat, as well as the wealth of essential information that remains undocumented. By comparing the data from the present inventory with that of Graham (2001), we identified the corresponding species, the uses of which in both studies are listed below, together with any other published sources.

Graham's (2001) study revealed that the Cashinahua commonly utilise *Pityrogramma calomelanos* (L.) Link (Pteridaceae) or *bai kudu* (HK) as a fumigant for protection against contagious disease epidemics. The current study suggests that this fern was burnt in the busiest parts of the village during the morning and evening rush hours. It was typically not burned alone but with the leafy branches of two other plants, namely *Ruizodendron ovale* (*kudu xai*) and *Zanthoxylum setulosum* (*kutan dau*). The term '*kudu*' translates to smoke or dust in the *Hantxa Kuin* language. Additionally, *P. calomelanos* can also provide effective protection against overpopulated insects that serve as vectors for diseases, such as dengue fever, malaria, and leishmaniasis. This species is utilised in ethnomedicine to address a variety of health issues, including venereal afflictions (Bardouille et al. 1978), pulmonary and gastric infections (Duke 2008), menstrual irregularities (Wong 1976), hypertension, and fever (Ayensu 1978), as well as coughs, colds, dizziness, hypertension, and wound healing (Coe and Anderson 1996), vertigo (Zamora-Martínez and de Pascual Pola 1992), bronchitis, stomach discomfort, inflammation, and as a postnatal invigorator (Murillo 1983). Phytochemical studies of *P. calomelanos* have revealed the presence of several flavonoids and several sesquiterpenes (Bardouille et al. 1978; Bohm 1968; Favre-Bonvin et al. 1980).

Among the spermatophytes (seed plants), concurrence with Graham's (2001) research was observed in the species discussed below. Additionally, there was some convergence in usage, although various uses identified by participants during the present study differ substantially and are frequently unknown in the existing literature.

As to the data on the use of plants of the Rubiaceae family in traditional Cashinahua medicine, we agree with Graham (Graham 2001) regarding the species *kawa* (*Psychotria viridis* Ruiz & Pav.), *matsi kawa* (*P. carthagenensis* Jacq.), *ixkin tepekan bata* (*Randia armata* (Sw.) DC.), and *xuniwan* (*Geophila macropoda* (Ruiz & Pav.) DC.). The species are identical, but apart from the use of *P. viridis* different uses were reported in this study. *R. armata* (25 UR) was used for the treatment of snakebites, respiratory infections, and skin diseases.

As an aid to hearing, Graham (2001) cited the use of *Justicia lineolata* Ruiz & Pav. (Acanthaceae), known as *pata dau matsi* or *manan heu pabinki*. It is suggested that the crushed leaves of this plant should be placed in the ear to enhance hearing. This study documents the same usage where the freshly crushed leaves of this plant are repeatedly inserted into the ear to address hearing loss. No literature reports regarding the ethnomedicinal use or biological activity of this species or its synonyms were found. The term '*pabinki*' translates to ear in the *Hantxa Kuin* language.

Graham (2001) notes that the finely-scraped bark of the stem of *Tabernaemontana markgrafiana* J.F.Macbr. (Apocynaceae), known as *xane tsamati* (HK), is placed in the eyes of a hunter who wishes to "see well" and be successful in a hunt. The shredded bark is also placed in a leaf of *mani pui* (*Calathea* spp.) and warmed near the fire in the form of *kawa* – patarashca. The expressed juice is then applied to stingray (*Potamotrygon* sp.) wounds and to toothaches. During the current study, we observed the use of this particular species to apply sap to the eyes, which is believed to bring good luck in hunting, and to treat stingray stings, which is consistent with Graham's (2001) research. The external application of the bark and leaves of *T. markgrafiana* was the most frequently reported use by study participants for treating postpartum ailments such as haemorrhage, headaches, and weakness. Infusions made from the bark of this plant are reportedly used in Brazil to treat fever, and externally as an antiseptic. Likewise, in Ecuador and Peru, the sap is used to alleviate toothache. There are also reports of women taking an infusion of the bark as a form of contraception. Several alkaloids and triterpenes have been extracted from the bark of *T. markgrafiana* (Nielsen et al. 1994). The ethanoic extracts of *T. markgrafiana* and *T. maxima* have shown an antagonistic effect against strains of *S. aureus* and *P. aeruginosa*, which can be attributed to the alkaloid content in these plants (Urresti et al. 2021).

Dracontium loretense K.Krause (Araceae), commonly referred to as *jergon sacha* in Spanish or *dunu yubin* in *Hantxa Kuin*, has been traditionally utilised for treating infections, respiratory complications, and snakebites. The corm of this plant is said to possess healing properties for snakebites and to aid with hand steadiness (Duke a Vasquez 1994). To prepare patarashca, the crushed corm of the plant is used, and the extracted juice is applied to the affected area. Alternatively, Rengifo and colleagues (Pinedo et al. 1997; Rengifo 2000) described the method of applying freshly grated corm directly to the wound or diluting it in a cup of cold water for ingestion. In bioactivity testing, Extracts of the plant were found to contain antioxidant activity (Desmarchelier et al. 1997). Polesna et al. (2011) found that among the mestizo and Shipibo residents of the Ucayali department, the corm of *D. loretense* was commonly used to treat ailments such as rheumatism and snakebites using a poultice, and gastritis via ingestion of a decoction. Its decoction was also used to treat injuries, nicks, pains, inflammation, haemorrhage, and kidney disorders, as well as tumours, rheumatism, and hernia. In addition, depression and sexual potency may be treated by regularly consuming a tincture (Polesna et al. 2011). To treat hernia, one must cook the corms and petioles until they produce a thick liquid, and then apply the liquid to the affected area (Pinedo et al. 1997). Graham (2001) discusses the effectiveness of freshly grated corm when applied directly to snakebites among the Cashinahua. The present study recorded the application of fresh crushed corms and petioles to treat snakebites (8 UR), as well as their effectiveness in treating facial paralysis (Bell's palsy) through washing with a decoction of the petioles or the whole plant (4 UR).

Chromolaena laevigata (Lam.) R.M.King & Rob. (Asteraceae), also known as *bai xaba* (HK), is a shrub commonly found in sandy beaches surrounding rivers and streams. Graham (2001) records the use of a fresh leaf infusion to bathe the head or to be dropped into the eyes of people suffering from malaise or depression. In Argentina, the plant is used as an emmenagogue (Ramirez et al. 1992) and in Brazil as an external antiseptic (Zani et al. 1995). Several diterpenes and sesquiterpenes have been extracted from this plant (Misra et al. 1985; de Oliveira et al. 2021), and antimicrobial activity was evaluated against *Candida albicans*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli*. From the crude essential oils extracted from *Ch. laevigata* leaves, stems, capitula, and cypselae during both its flowering and fruit stages, 38 compounds were identified. The sesquiterpen laevigatin revealed the greatest efficacy against *C. albicans* and *S. aureus* (Murakami et al. 2013). This study recorded the external application of a *Ch. laevigata* leaf decoction as a newborn protectant and to bathe patients with severe vomiting and fainting, as well as the ingestion of fresh leaves soaked in cold water to treat the same malady. Study participants also mentioned using a warm bath with a decoction of *bai xaba* leaves to treat fever and address spirit attacks.

The juice derived from the leaves of *Porophyllum ruderale* (Jacq.) Cass. was reported by Graham (2001) as being ingested orally and applied into the eyes for the treatment of malevolent spirit attacks. In the present research, the application varies: in four cases, study participants mentioned bathing in a warm leaf decoction of the leaves of *P. ruderale* or *nai xaba* (HK) as a treatment for any severe illness, and in one case, they reported treating dizziness, fainting, and vertigo, which are also symptoms of a spirit attack. In Peru, the infusion of *P. ruderale* is used to treat "susto", a folk disease (Ramirez et al. 1992). The hydroalcoholic extract of the aerial part of the plant contains compounds that can be used in the treatment of acute kidney injury, according to Vásquez.Atanacio et al. (2022). Takahashi and colleagues (Takahashi et al. 2013) demonstrated the antiproliferative activity of *Leishmania amazonensis* promastigotes and axenic amastigote forms. Phenolic acids, including caffeic acid derivatives, were found to be responsible for the anti-inflammatory effects observed in the extract obtained from the aerial parts of *P. ruderale* (Pawłowska et al. 2022).

This study documented the internal and external use of the leaves of *Quararibea wittii* K. Schum. & Ulbr. (Malvaceae), known as *tui pei* (HK), crushed in water to help speed up childbirth, to protect expectant mothers during pregnancy, and to protect newborns. In addition, drinking fresh sap from the leaves of this tree with a small amount of water can induce abortion, according to Graham (2001). No literature sources were found regarding the ethnomedicinal use, bioactivity testing, or phytochemical analysis of *Q. wittii*. However, according to Duke (1994), the fruit of *Q. cordata* is used in Peru for dysmenorrhea. Furthermore, an infusion of the flowers of *Q. funebris* is reported to be used in Mexico as a menstrual regulator, and several alkaloids have been isolated from the flowers of this species (Zennie et al. 1986).

Another plant cited by Graham (2001) in his research, and referenced in our study, is *Clitoria pozuzoensis* J.F.Macbr. (Fabaceae) or *iska nixi* (HK). In the present investigation, out of the ten uses mentioned by the participants, nine pertained to employing long-acting contraceptives. To achieve this, a decoction of the leaves, bark, and perhaps root of this plant is ingested. This is accompanied by abdominal or vaginal douching, as well as application of the decoction into the eye. As previously noted, this practice is conventionally linked with rigorous dietary restrictions and abstaining from sexual activity while utilising the remedy, with its duration being directly tied to the length of contraceptive protection. Graham (2001) recorded that fresh leaves from this plant are combined with *punu chiva* (Rubiaceae) to create an infusion, which is used to bathe the stomach of a pregnant woman, with the belief that it will induce childbirth the next day. No reports on the use of this species in ethnomedicine, testing of its biological activity, or analysis of its phytochemical properties were found in the existing literature.

The present research with regard to the utilisation of *Goeppertia standleyi* (J.F.Macbr.) Borchs. & S.Suárez (Marantaceae) or *tsau mani* (HK) concurs with Graham's (2001) findings. Primarily teenagers masticate the supple bud stalks at the end of plant stems for dental preservation and to impart a vivid blue tinge to the teeth, tongue, and lips (Graham 2001; Graham et al. 2004). Cashinahua plant specialists explained that gum discolouration is used to show the approval of young hunters after their first successful hunt of a large animal, including tapir (*awa*) or peccary (*yawa*), and is associated with the use of young shoots from a range of *Piper* species. These *Piper* sprouts are utilised in the ceremonial practice of tooth blackening, alongside the gum discolouration that results from chewing the sprouts of *G. standleyi*. According to Cashinahua belief, an individual possesses a physical body that is animated by numerous individual spirits (Kensinger 1995), among which is the tooth spirit, *xeta yuxin*. Tooth decay and tooth loss are associated not only with the physical effects of diet and dental hygiene, but also with the loss of the tooth spirit from the body. By chewing *G. standleyi* during the *Nixpu Pimaa* ritual, a positive medical effect can be achieved through its prophylactic and cariostatic physiological activity, as well as by protecting and conserving the *xeta yuxin* in the body (Graham et al. 2004). No reports on the use of this species in ethnomedicine, testing of its biological activity, or analysis of its phytochemical properties were found in the existing literature.

Abuta grandifolia (Mart.) Sandwith (Menispermaceae) or *kanapan binu* (HK) is one of the plants most frequently mentioned and used by Cashinahua herbalists in this survey. The plant is widely used for medicinal treatments and plays a significant role in cultural and economic contexts. The 2010 medicinal plant database compiled by the Instituto de Investigaciones de la Amazonía Peruana (IIAP) documents various uses of *A. grandifolia*, including treatment for anaemia, female infertility, and hypocholesterolaemia, as an aphrodisiac, antimalarial, antihemorrhagic, and cardiotonic, brain stimulation, dental analgesia, soothing menstrual cramps and rheumatic pains, and curing stomach ulcers and typhoid fever. Alexiades (1999) documented the use of *A. grandifolia* by the Ese Eja as a male aphrodisiac, a finding consistent with those of Elisabetsky et al. (1992) in Guiana. Graham (2001) recorded the consumption of a leaf infusion of *kanapan binu* by Cashinahua men for stimulating their sexual organs, which agrees with the findings of the current study. Other uses reported by study participants included ingestion of a leaf and bark decoction to restore physical strength, as a tonic and male aphrodisiac, and friction with heated leaves to increase male sexual potency. Additionally, a decoction of the leaves of this plant was mentioned for treating cramps and diarrhoea with vomiting by rubbing the affected area. The bark of this plant is said to be used in Colombia for the preparation of arrow poison. The stems, bark, and wood of *A. grandifolia* were subjected to phytochemical analyses, resulting in the identification of bisbenzylisoquinoline alkaloids with the potential to inhibit acetylcholinesterase as a treatment for Alzheimer's disease (Cometa et al. 2012; Konrath et al. 2013; Nabavi et al. 2019).

In the study area, *Myrcia hylobates* (Standl. ex Amshoff) E.Lucas & K. Samra (Myrtaceae) is known as *amen tedeku* (HK). Graham (2001) documented this species with a different vernacular name, and reported its use to treat cough and associated chest pain by bathing in a decoction of the leaves. This decoction is also utilised to manage cases of fainting or unconsciousness, which may arise following the killing of a large serpent. The present study documented the use of warm baths in a leaf decoction for the treatment of severe convulsions, which are interpreted as "epilepsy of capybara" (*Hydrochoerus hydrochaeris* - *amen* in HK). If this condition needs urgent attention, expressing leaf juice directly into the eye is also an option. The leaf decoction is additionally used to bathe the head in cases of cephalea (headache). No studies exploring the application of this species in ethnomedicine, its biological activity, or phytochemical properties were identified in literature searches.

Out of the 27 *Piper* species reported by Graham (2001), only two taxa were also recorded in this study: *yaix maxaka* (*P. nudilimbum*) and *txexen pei* (*P. peltatum*). The first one was reported by Graham to be used to treat skin blemishes and mycotic infections, which coincides with the results of the current research, as these two species were reported to treat scabies, skin conditions, skin protuberances in the vagina or anus, genitourinary infections, and as a general restorative. In addition to the common use of *P. peltatum* in treating intestinal parasitosis, other uses such as treating stingray stings, cephalea (headache), and fainting were documented.

According to Graham's (2001) research, the warm juice extracted from the leaves of *Piper nudilimbum* C.DC. (Piperaceae), or *yaix maxaka* (HK), prepared as patarashca (*kawa*) can be used to cleanse the skin, treat light-coloured splotches, and cure fungal infections. This study recorded the use of the same preparation for skin irritations, protuberances, and scabies. Additionally, study participants utilised a concoction of *yaix maxaka* leaves for enhancing muscle strength, and heated leaves in the form of a plaster to alleviate libido problems. No reports on the use of this species in ethnomedicine, the testing of its biological activity, or an analysis of its phytochemical properties were found in the existing literature.

Graham (2001) presents the use of *Piper peltatum* L. or *chexen pei* (HK) as follows: the plant's large leaves are utilised to treat intestinal worms, known as *pui xena*, which manifest in the faeces. The individual afflicted by this condition excretes onto the foliage of this plant, subsequently wrapping the leaves around the waste and surreptitiously concealing it within the woodland. The worms disappear from the individual once the bundle of leaves has decomposed. Findings from the current study reveal that the use of leaf juice, prepared in the form of patarashca or crushed with a small amount of water and applied to the patient's abdomen, can effectively treat parasitosis. Application of this treatment is also used for treating stingray (*Potamotrygon* sp.) stings, where it is applied directly on the wound. Additionally, a warm bath in a decoction of leaves is recommended for the treatment of headaches. *P. peltatum* is commonly employed by various Amazonian cultures to treat inflammation, malaria, and other medical conditions (da Silva et al. 2010). Additionally, the leaf extract of this plant exhibits anti-inflammatory, cytotoxic, and antimicrobial properties (Michel et al. 2016).

The use of *Geophila macropoda* (Ruiz & Pav.) DC. (Rubiaceae), or *xuniwan* (HK), was recorded for the treatment of toothache, inflamed teeth, and gingivitis, either by using a decoction of the leaves as a mouthwash or by squeezing the juice of the leaves directly onto the affected area. A decoction of *xuniwan* leaves is also used in warm baths to treat inflammation. Graham (2001) reported that ripe fruits from this plant are applied to the soles of the feet of children who are unable to walk, allegedly giving strength to their bones. No records of the use of this species in ethnomedicine, the testing of its biological activity, or an analysis of its phytochemical properties were discovered in the existing literature.

The decoction of *Psychotria carthagenensis* Jacq. (Rubiaceae), or *matsi kawa*, was reportedly used by the Cashinahua for headaches when applied as a warm bath. Additionally, Graham (2001) reported the interchangeable use of the leaves of this plant and of *Psychotria viridis* for the preparation of the psychoactive beverage known as *nixi pae*. This beverage is made using a strong decoction of the stem of *Banisteriopsis* (Malpighiaceae), along with the leaves of the abovementioned plants; it is believed that the addition of leaves of *P. carthagenensis* Jacq. strengthens the hallucinogenic effect of the beverage. Sanz-Biset (2009) reported ethnomedicinal uses for four *Psychotria* species (*P. alba* Ruiz & Pav., *P. carthagenensis* Jacq., *P. ernestii* K. Krause, and *P. viridis* Ruiz & Pav.), including their use as a depurative and for treating rheumatism. These species were also used to treat inflammation, respiratory diseases, and hallucinations (Formagio et al. 2014). A study carried out on several species of *Psychotria* revealed that *P. carthagenensis* exhibits the most significant antioxidant activity (Formagio et al. 2014). This species also contains flavonoids, condensed tannins, and flavonol. *Psychotria* leaves are widely recognised as ingredients in the entheogenic beverage known as ayahuasca (Egg 1999). The Cashinahua also utilise the leaves for this purpose. According to study participants*, P. alba* or *matsi kawa* (HK) is also used in the preparation of *nixi pae* (ayahuasca). In order to increase the potency of this brew, Cashinahua plant specialists combine the leaves of *Renealmia brevicaspa* (Poepp. & Endl.) Poepp. & Endl., known as *itsami* (HK). Indole alkaloids and sterols were isolated from the leaves of *P. viridis* and *P. carthagenensis* (Lopes et al. 2000). For further details, refer to Sections 2.4.1 and 5.1.6.

Randia armata (Sw.) DC. (Rubiaceae), or *ixkin tepekan bata* (HK), is one of the most frequently cited plants in this study. The treatment of tonsillitis is the most commonly reported use of this plant. Its efficacy in treating this condition is achieved through ingestion of a liquid extract derived from leaves soaked in a small amount of water. Additionally, it is used to alleviate pharyngitis by applying the warm juice of the leaves prepared in the form of “patarashca” to the affected area. The social and cultural practices involve utilising a warm bath in the decoction of the leaves to soothe a child who is crying day and night, and to treat a child who refuses to leave his mother's side. Graham (2001) also noted that *R. armata* var. *pubescens* leaves are crushed and mixed with water to bathe a child who does not want to leave its mother's side. No reports were found in the available literature regarding the use of this species in ethnomedicine, its biological activity, or its phytochemical properties.

The fruits of *Solanum nemorense* Dunal or *i txiux* are crushed and applied to the breasts of mothers whose infants are reluctant to cease breastfeeding, aligning with Graham's (2001) research. In addition, if a mother experiences mastitis, she can extract juice from crushed leaves and mix it with a small amount of water before applying it to her breasts. The most frequently cited use of *S. nemorense* among the study's participants is the treatment of the abscess. Eating *i txiux* fruit is believed to prevent abscesses, while its leaves are applied to affected areas in a similar way to treat mastitis. The leaves can be heated and used as a compress. No literature reports were discovered on biological activity testing or phytochemical analysis for this species.

Xau is the Cashinahua word for bone. Rubbing leaves of *Solanum sessile* or *xau bata*, crushed in a small amount of cold water, onto painful joints and bones is an effective remedy for alleviating joint and bone discomfort. However, the treatment of *kamux* (*Lachesis* sp.) snakebites during the initial and intermediate stages of healing is the most reported use of this plant. During the first phase, the wound is treated every 3-5 minutes with juice extracted from fresh leaves or from leaves heated in the form of "patarashca". In the second phase of treatment, the inflammation caused by the bite is alleviated through warm baths using a decoction of leaves. For the treatment of inflammation caused by caiman bites, a warm bath with a leaf decoction is used. According to Graham (2001), *xau bata* leaves are crushed in cold water and the resulting liquid is used to bathe a body that has become overheated because of strenuous exercise, which is consistent with present study. The same treatment is used for children or adults who perspire excessively, a finding of both the current study and that of Graham (2001). According to Graham's research, this fluid may also be used to bathe distressed babies and alleviate swelling in the testes. No literature reports of ethnobotanical use, biological activity testing, or phytochemical analysis were discovered for this particular species.

Leonia glycycarpa Ruiz & Pav. (Violaceae), also known as *tunku dau bata* in HK, is one of the most frequently cited plants by Cashinahua plant specialists. The plant is commonly used for treating poisonous snakebites, specifically those from *kamux* (*Lachesis* sp.) and *shanu* (*Bothrops* sp.) during both the first and second stages of treatment. The use of *L. glycycarpa* in the treatment of snakebites by applying freshly chewed leaf juice directly to the wound was also mentioned by Graham (2001). In addition, several participants noted the use of *tunku dau bata* leaves to treat tumours (*hi tunkuya*) that can develop in any part of the body. Tumours are treated by consuming an infusion of the leaves, taking a cold bath in a leaf infusion, or applying the heated leaves as a poultice to the affected area. Furthermore, *tunku dau bata* is often used to treat goitre, abscesses, and hip or shoulder pain by massaging the affected area with a decoction made from the leaves. The drinking of a leaf decoction has also been recorded as a remedy for infectious diarrhoea. No reports of ethnomedicinal use, biological activity testing, or phytochemical analysis were found for this species.

Rinorea lindeniana (Tul.) Kuntze (Violaceae), also known as *xani kaxa* or *awa tae shiwen* (HK), is utilised for strengthening the body through bathing in a decoction of its leaves. Furthermore, it has been used for treating severe convulsions, known as *yawa bakea* or peccary epilepsy. In the event of an emergency, the juice of *xani kaxa* leaves can be expressed into the eyes to alleviate this malady. The juice extracted from the leaves is also applied to wounds to facilitate their healing. Graham (2001) reported the application of chewed leaves of this plant on the bite of the giant ant *buna* (*Dinoponera* sp. or *Paraponera* sp.). No literature reports of ethnomedicinal use, biological activity testing, or phytochemical analysis were found for this species.

The use of a decoction of the root of *Zamia ulei* Dammer (Zamiaceae) or *yuxinen mani* was reported by Graham (2001) for the treatment of internal tumours. The use of this decoction also serves as a male aphrodisiac, which is consistent with the findings of this study. Respondents in the current study also mentioned the use of leaves of this plant in a decoction to bathe a person suffering from a *yuxin* attack, and the use of a root decoction to treat impotence and as a restorative after prolonged illness. For a person who faints, cries, and does not eat, the use of the juice from ground leaves pressed into the eyes is considered a remedy. No literature reports of ethnomedicinal use, biological activity testing, or phytochemical analysis were found for this species. *Zamia ulei* was last assessed for the IUCN Red List of Threatened Species in 2020 (IUCN 2022).

Cashinahua herbalists exhibited extensive knowledge during fieldwork, successfully identifying a multitude of plant species. The collected data demonstrate that the Cashinahua have established a hierarchical system for categorising plants according to their medicinal value.

This study compares Peruvian Cashinahua medicinal plant use with that of four neighbouring ethnic groups: Ese Eja, Chayahuita, Quechua and Brazilian Kaxinawa. The comparison shows that most of the plant uses of these ethnic groups differ significantly from those of the Peruvian Cashinahua. Therefore, the uses of the same species are largely novel compared to the existing literature. In addition, the comparison highlights the contrast in medicinal plant use between the Peruvian and

Brazilian branches of the same ethnic group. Table A3, which provides a detailed comparison of identical medicinal plant uses, can be found in the supplementary material as Appendix 3.

6.2. Scientifically neglected species used by the Cashinahua

Some of the taxa reported in Table A2 have the same uses as other species of the same genus; this is the case for *Quararibea wittii* K.Schum. & Ulbr. and *Q. guianensis* Aubl., *Drymonia coccinea* (Aubl.) Wiehler and *Drymonia semicordata* (Poepp.) Wiehler, *and Paullinia tenera* Poepp. & Endl. and *Paullinia* sp., among others. Similarly, in his dissertation thesis, Graham (2001) mentioned 19% of the species found in the current study, 7% (4 species) of which present taxonomic correspondence of genera and species, with similar local names, while he mentioned 14% (8 species) with the same genus but other species and different local names.

We also cross-checked our 79 species with the World Checklist of Useful Plant Species, which includes 40,292 plant species (Diazgranados et al. 2020), and found that none of the four *Philodendron* spp. and three *Piper* spp. from this study have been reported previously. Remarkably, even though *Solanum* was the most cited "useful genus" (with 328 species) in the checklist, none of the four species included in this paper have been reported before for any medicinal usage.

Also, only 5 out of the 79 species in this study (*Cordia nodosa* Lam., *Centropogon cornutus* (L.) Druce, *Tradescantia zanonia* (L.) Sw., *Desmodium axillare* (Sw.) DC, and *Leonia glycycarpa* Ruiz & Pav.) are included in the list of more than a thousand medicinal plants used in the Peruvian Amazon published by the Instituto De Investigaciones De La Amazonia Peruana (IIAP 2010).

Of the 79 scientifically under-reported species in this research, 11% (12 species) were also described by Manduca et al. (2014b), who discussed the traditional medicine of the Brazilian Kaxinawa, with some variations in phonetics and spelling in Hancha Kuin; 6 species present the same taxonomy, with *Leonia glycycarpa* Ruiz & Pav., *Clavija weberbaueri* Mez, *Nautilocalyx pallidus* (Sprague) Sprague, *Aphelandra acrensis* Lindau, *Cordia nodosa* Lam. and *Prunus myrtifolia* (L.) Urb. being the most frequently mentioned.

6.3. Herbal treatment of important neglected tropical diseases

Leishmaniasis has recently been re-included in the World Health Organization's list of neglected tropical diseases (Bhaumik et al. 2018). As mentioned above, the Pan American Health Organization reports that leishmaniasis is one of the top ten neglected tropical diseases in the world, infecting more than 12 million people. In Peru, cutaneous leishmaniasis (CL) is endemic. The options available to prevent and control it are limited. Successful vector control is essential for the management of some arthropod-transmitted NTDs. In addition to leishmaniasis, these include dengue fever and malaria. Leishmaniasis was recently re-added to the list of neglected tropical diseases by the World Health Organization (Bhaumik et al. 2018). The Pan American Health Organization highlights that leishmaniasis is one of the top ten neglected tropical diseases worldwide, with over 12 million people infected. Of the nine countries that report 85% of the cases, three are located in the Americas, including Peru, where CL (cutaneous leishmaniasis) is an endemic disease. The prevention and control options available for CL are limited. Therefore, individuals who have been exposed should take measures to reduce contact with the vector. The Cashinahua tribe predominantly utilise *Jacaranda glabra* (DC.) Bureau & K.Schum. leaves to treat both initial and advanced cases of leishmaniasis. Leafy branches of *Ruizodendron ovale* and *Tanaecium dichotomum*, along with *Pityrogramma calomelanos* leaves, are used by the Cashinahua community in the form of fumigation to prevent leishmaniasis and other arthropod-transmitted diseases in the event of a population explosion of an insect vector.

An overview of the most common categories of ailments treated with medicinal plants in the study region is given in Table 1. Of these, venomous bites, which were added to the list of NTDs in 2017 (WHO 2022), are the most commonly reported in the survey. The majority of envenomations in our study are snakebites. Other venomous animal stings and bites include scorpions and spiders. The herbal treatment of snake bites by the Cashinahua has been described in detail in section 5.3.1 above. The Cashinahua people employ *Lygodium venustum* to treat snakebites from *Bothrops bilineatus* (*kana dunu*), inflammation, bleeding, toothaches, arthritis, rheumatism, and pain in general. The use of *L. venustum* for scorpion sting treatment has been documented in Pakistan (Butt et al. 2015).

The species most reported for their antiherpetic effects are *Pseuderanhemum congestum*, *P. lanceolatum*, *Caamembeca gigantea*, and *C. spectabilis*. No previous reports of medicinal use were found for the first-named species, while the second-named species has only been reported in the community of Caruarú, Brazil (de O Mesquita a Tavares-Martins 2018). These medicinal plants, which are seldom mentioned, warrant further investigation.

6.4. "Baños" and the advantages of transdermal drug delivery

The overwhelming preponderance of externally applied remedies versus internal administration may seem surprising, but it is not uncommon among Amazonian and Andean ethnic groups (Bussmann et al. 2010b; Bussmann and Sharon 2015). Alexiades (1999), in his dissertation on the traditional medicine of the Indigenous Amazonian Ese Eja people, mentioned that 70% of remedies consisted of external treatments which involved direct contact of plant tissue with the affected body part. The skin offers an accessible and convenient site for the administration of medications. To this end, the field of transdermal drug delivery, aimed at developing safe and efficacious means of delivering medications through the skin, has garnered much time and investment with the continuous advancement of new and innovative approaches (Alkilani et al. 2015). It should be borne in mind that the conventional use of medications in the form of oral administration must overcome the first pass effect, where the active substance enters the digestive tract and undergoes metabolic changes in the liver, which greatly slows down the onset of action as well as alters its effects. Kováčik et al. (2020) claim that the clinical advantages of transdermal drug delivery over traditional administration methods are numerous. In addition, a transdermal drug delivery system has been accepted as a potential non-invasive route of drug administration (Rizwan et al. 2009). However, oral delivery has the advantages of allowing for pre-determined doses, portability, and patient self-administration. For these reasons, the oral route in Western culture remains the most convenient means of delivering medications (Brambilla et al. 2014; Ita 2014). Ingestion was applied for a wide range of ailments, mainly for the treatment of digestive, genitourinary, and respiratory problems, as well as socio-cultural uses such as behavioural regulation and the *nixi pae* (ayahuasca) ceremony.

A special form of application used by different Amazonian ethnic groups (Graham 2001; Luziatelli et al. 2010) is ocular administration (5.6%),or the instillation of crushed leaf juice directly into the eyes, which Cashinahua herbalists use to treat conjunctivitis, sties, affections of sight, and headaches. However, its most frequent use was during an episode of fainting, dizziness, and strong convulsions (a *yuxin* attack) that healers compared with epilepsy, in addition to socio-cultural and magical uses such as sorcery and “panema”, i.e., misfortune in hunting. Another common ocular application of specific plant juices was before a hunt, so that game could be seen well in the shade of the forest.

6.5. "Dietas" - food and behavioural taboos in support of medicinal plant use

Strict diets are a common Amazonian medicinal practice in which herbal remedies are consumed during a period of near fasting and some form of social seclusion. These well-structured, traditional medicinal practices also hold symbolic significance in the life cycle. The plants used in these diets can aid in anti-inflammatory, anti-infective, psychoactive, and depurative actions (Sanz-Biset and Cañigueral 2011). It has been found that strict diets are used primarily to restore or enhance human health, for hunting and fishing preparedness, and are part of a ritualistic way of life and healing, especially for men. In each case, strict diets seem to produce intense experiences that are considered to be curative because a) they always produce depressant effects, b) they usually have their origin in other physiological or pharmacological effects that are considered to be health-enhancing or useful against musculoskeletal or infectious diseases, and c) they sometimes produce holotropic states of consciousness, i.e., states that are oriented toward feelings of wholeness. Strict diets have also been found to apparently maintain general structure. Elements that showed some variabilities were the length, level of seclusion, and herbal preparations used.

These practices are part of traditional medicine, which usually includes dietary restrictions and additional norms while using plant remedies (Sanz-Biset et al. 2009). In the Amazon, this is referred to as the "dieta" and is often associated with the term "dietar plantas". It is generally believed that plant-based remedies require specific and deliberate timing to effectively treat ailments, unlike pharmaceuticals. Plant-based remedies are typically taken daily for a recommended duration, during which it is advised to rest, to limit sexual activity, and to avoid consuming heavy foods and alcohol, as well as using perfumes and other strong odours. To achieve the desired healing benefits of herbal remedies, adherence to these restrictions is essential. Jauregui (Jauregui et al. 2011) suggests that the system of "dietas" are key elements of traditional medicinal practices, which help to maintain the cultural continuity in Amazonian societies located in East-Central Peru.

6.6. Conservation status of reported medicinal plants

Culturally undisturbed regions, such as the Curanja River area, continue to harbour considerable biocultural richness. In this region, as in other parts of the world, plant use and conservation may be in conflict. Some plant species may suffer from high collection pressure for medicinal purposes, as has been noted in several countries. (Sanz-Biset et al. 2009; Odonne et al. 2013; Fagan and Shoobridge 2007; Lange 1998; Sheldon et al. 1998). However, the Cashinahua only consume the plants and animals they need to survive, and do not hunt or harvest more than they need to meet their basic needs, they benefit from the flora and fauna without destroying it, and they fully respect the natural environment. There is no room for species accumulation or indiscriminate exploitation, as they violate the principles overseeing human interaction with nature. The cultural richness that assists these communities in living in accordance with nature is known as ancestral knowledge. Another positive aspect of the conservation issue is the remoteness and inaccessibility of the province, particularly the upper reaches of the Curanja River, which significantly limit the presence of outsiders (Graham 2001). This has led to the collection of medicinal herbs solely for use among local patients. The low population density in the province and dense primary forest that surrounds the communities also makes it unlikely that collecting wild herbs would pose a threat to their existence. Therefore, harvesting medicinal plants would not typically raise conservation concerns, apart from a small percentage of plants whose roots are utilised, such as *Dracontium* spp. Among these taxa, *Zamia ulei* tubers hold high value for their contribution to the general recovery of the body after a long illness. Nevertheless, this plant is frequently utilised to cure erectile dysfunction and enhance libido, much like the decoction of *Abuta grandifolia* leaves and stem bark. These two plants are the only ones recorded as being traded, in that small quantities are sent to Pucallpa for sale. As far as we are aware, no other plants are collected for retail. *Manihot brachyloba* (IUCN Red List), known for treating headaches and fainting, is commonly transplanted along the edges of manioc fields (chacras) for its protection, leading to its proliferation rather than posing a threat.

6.7. Vulnerability of the Curanja River communities

The rapid cultural change experienced by Indigenous families in Purus communities exacerbates their health vulnerability. Change is to some extent better absorbed and processed by populations that are demographically stronger, and thus epidemics and changes have been extremely devastating in cases where Indigenous populations have been reduced to a hundred people or less. In the former case, communities have been able to overcome health crises, begin to grow, and to some extent adapt to change through bilingual education, which has strengthened their sense of collectivity. The Cashinahua of the upper and middle Purus are such a case (Ministerio de Salud del Perú 2009). Although the massive epidemics that caused high mortality rates in Purus are now a thing of the past, the role they played, not only in the demographic evolution of the Indigenous population and their settlement patterns, but also in the acceptance of elements of Western medicine, the weakening of the Indigenous medical systems of Purus, and their perception of vulnerability, cannot be overestimated.

Moreover, recent tragic events have caused those who live in unconnected communities along the upper reaches of the Curanja River to feel threatened, and thus whole communities are moving downstream to more populated areas that lack the same protected biological environment. Specifically, four members of the Mastanahua family, who served for two decades as mediators between the mestizo society and populations in voluntary isolation in the Purus rainforest, were killed in November 2020. This tragic incident has yet to be fully understood. In its official communiqué (No. 315883), the Ministry of Culture details the deaths of four Indigenous citizens in initial contact (PICI) who had settled near the Cashinahua Native community of Santa Rey in Purus Province. An investigation of the incident claims that the deaths took place during a confrontation between the deceased and members of an Indigenous tribe in voluntary isolation. It states that it was agreed upon with the members of the community that they would be evacuated to the city of Puerto Esperanza to safeguard the integrity and safety of the members of the Santa Rey Native Community as well as the Indigenous peoples living in isolation in the surrounding area. In addition, meetings were held with the authorities of the native communities of El Triunfo, Colombiana, Curanjillo, and Nueva Luz and the locality of Nueva Vida, to strengthen prevention measures in the event of an incident involving Indigenous peoples in isolation. Fears for their own safety, together with repeated raids by Indigenous people living in voluntary isolation to obtain metal tools, led to the abandonment of the communities of Santa Rey and Colombiana and the construction of new communities with the same names along the lower reaches of the Curanja River. These new communities do not yet have access to drinking water, nor have any schools been built (information provided by community members).

The preservation of the traditional values and knowledge systems of these remote Cashinahua communities is threatened by the factors mentioned above, compounded by the current situation of increased migration of the younger Indigenous population to cities for access to education, health services, and basic needs, and, in the case of the older generation, the migration of entire families to Brazil in search of better social security. In the case of the Cashinahua, Lagrou (1991) noted that since the 1950s communities established in Peru have been affected by the loss of specialists and high mortality rates during epidemics. In the ASIS workshops, Cashinahua participants also emphasised the recent loss of specialists due to the constant migration of older people to Brazil. They added that the medical and cultural tradition in general is maintained with greater vitality in Brazil because of the promotion of Indigenous identity and culture, for example, through intercultural bilingual education, the publication of books, and more favourable policies (Ministerio de Salud del Perú 2009).

7. Conclusions

The natural habitats of the Curanja River basin were found to be rich in medicinal plants, with 85.1% of the taxa collected exclusively from the wild and 44% of the species collected from riparian forests. The majority of species (80.7%) were collected from surrounding areas. The results of the study show that Cashinahua plant specialists transplanted rare or difficult to find species to forest gardens close to the community. This suggests a tendency towards the initial domestication of these species, as well as highlighting their therapeutic value. Of the 467 taxa, 83.5% were of native origin, while 55 previously undocumented species were added to the Peruvian flora.

The research demonstrates that male specialists from the Cashinahua tribe have in-depth knowledge of the use of a wide range of plant species to treat common and serious, but neglected, tropical diseases prevalent in their area, while female specialists have extensive knowledge of medicinal plants used to treat reproductive health conditions and facilitate family planning.

The hypothesis (1) proposing that the Cashinahua employ a multitude of medicinal plant species for treating a wide spectrum of health disorders is supported by the recorded use of 467 different species with 3,164 different uses. The hypothesis (2) suggesting that the use of medicinal plants by the Cashinahua is influenced by social and cultural factors is supported by the observation that their medical practices are established within their cosmology and environment, contributing to cultural continuity and fostering social coherence. The documented use of 79 species that are currently not listed in the WOS database as having medicinal or ethnobotanical uses, nor tested for biological activity, supports the hypothesis (4) that the Cashinahua use a variety of overlooked medicinal plant species. The distribution of species with little or no pharmacological documentation is spread over 60 genera and 42 botanical families, with Acanthaceae being the most represented, and *Pseuderanthemum lanceolatum*, *Leonia glycycarpa*, and *Piper reticulatum* attaining the highest use values.

This study represents the first quantitative and comparative ethnobotanical analysis conducted within the geographic region of the Central Amazon. The most notable affinity in species was found with medicinal plants that are traditionally implemented by the Brazilian Kaxinawa, located within the State of Acre, Brazil.

In the isolated, overlooked, and poverty-stricken region of Purus Province, with low development prospects, ancestral knowledge may be particularly important for the resilience of Indigenous populations undergoing rapid socio-economic, cultural, and environmental change.

This study contributes to filling the gap in the documentation of Cashinahua Indigenous knowledge, which, if studied using modern ethnobotanical approaches, may reveal neglected and underutilised plant species.

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9. Supplementary Material

Appendix 1: Table A1 467 Cashinahua medicinal species documented in our study.

Appendix 2: Table A2 79 Cashinahua medicinal species unreported or rarely cited for medicinal use or phytochemical analysis and their traditional uses

Appendix 3: Questionnaire presented to plant specialists

Appendix 4: Household questionnaire presented to community members

Appendix 5: Photos from field work

Appendix 6: Photos from herbarium work

Appendix 7: The Field Guide of the neglected plants submitted to Field Museum in 2021

Appendix 8: Cover page of hard copy of transcriptions of recordings in *hancha kuin* language

Appendix 9: Example of one page of hard copy of transcriptions of recordings in *hancha kuin* language

Appendix 10: Table A3 Demographic data of respondents and number of UR registered

Appendix 11: Example of outcome of Community Workshops with Cashinahua primary school children

Appendix 12: List of publications, manuscripts and conference contributions based on the doctoral study

Appendix 13: Author's Curriculum Vittae

Appendix 1: The list of 467 documented medicinal plants

Table A1 467 Cashinahua medicinal species documented in this study.

FAMILY **species (voucher specimen)**[1]	**vernacular name(s)**[2]	**part(s) used**[3]
ACANTHACEAE		
Aphelandra caput-medusae Lindau [HOR079]	*basikun beshiwa*	leaves
Aphelandra aff. *dolichantha* Donn.Sm. [HOR283]	*atsa xua (atsa pusi)*	entire plant
Aphelandra sp. [HOR325]	*chana chixin yame chana*	leaves
Aphelandra acrensis Lindau [HOR087, HOR241, HOR355]	*yame bebe*	leaves
Aphelandra lasiandra (Mildbr.) McDade & E.A.Tripp [HOR143, HOR511]*	*yawan kuxi dau bata*	aerial part
Aphelandra maculata (Tafalla ex Nees) Voss [HOR522]	*yametawan pei xiwaya*	leaves
Dianthera pectoralis (Jacq.) J. F. Gmel. [HOR471]	*taku dexni*	aerial part
Dicliptera squarrosa Nees [HOR416]	*nixu dania*	leaves
Fittonia albivenis (Lindl. ex Veitch) Brummitt [HOR310, HOR242]	*kain tanken*	leaves
Herpetacanthus rotundatus (Lindau) Bremek. [HOR372]	*matsi bedea (bakan matsi bedea)*	leaves
Justicia aff. *yuyoensis* Wassh. & J.R.I.Wood [HOR047]	*matsi pei mexiupa (bakan matsi)*	leaves
Justicia aff. *aphelandroides* (Mildbr.) Wassh [HOR083]	*chana chixin yametanwan*	leaves
Justicia sp.1 [HOR277]	*xakada himi (xakada istutu)*	leaves
Justicia sp.2 [HOR418]	*nuin txaxu hubua (xane natu)*	leaves
Justicia sp.3 [HOR451]	*nin pidi*	entire plant
Justicia boliviana Rusby [HOR456]	*nanpen tsiva*	leaves
Justicia dumetorum Morong. [HOR472]	*matsi dantunkuya*	entire plant
Justicia lineolata Ruiz & Pav. [HOR365, HOR488]*	*manan heu pabinki, pata dau matsi*	leaves
Lepidagathis ipariaensis Wassh. [HOR357]	*atsa xua pusia (astua matsi)*	leaves

[1] Taxonomy follows Plants of the World Online (2023), APG IV (2016), PPG I (2016), and Goffinet and Buck (2004). [2] Vernacular names in *Hantxa Kuin*.

Mendoncia pedunculata Leonard [HOR086]	*bunpa pei shiwaya*	leaves
Pachystachys cf. *cordata* (Nees) A. L. A. Côrtes [HOR372]	*yametawan pei huxupa*	leaves
Pseuderanthemum sp. 1 [HOR007, HOR098, HOR300]	*dunu himi*	aerial part
Pseuderanthemum sp. 4 [HOR385]	*kuntsa*	leaves
Pseuderanthemum congestum (S.Moore) Wassh. [HOR372]	*xuke bibex bata pei chudi*	leaves
Pseuderanthemum lanceolatum (Ruiz & Pav.) Wassh. [HOR372]	*mikin medan putani bata*	leaves
Pulchranthus adenostachyus (Lindau) V.M.Baum, Reveal & Nowicke [HOR460]*	*xuke bibex bata pei ewapabu*	leaves
Ruellia aff. *proxima* Lindau [HOR367, HOR421]	*bakan matsi, bexu maxu*	leaves
Sanchezia sp. 1, 2, 3 [HOR117, HOR334, HOR400]	*dei yuxibun bixtu*	leaves
Sanchezia cf. *oblonga* Ruiz & Pav. [HOR198]	*bakan matsi*	bark
Sanchezia ovata Ruiz & Pav. [HOR198]	*bichu xau matsi*	leaves
Sanchezia scandens (Lindau) Leonard & L.B.Sm. [HOR356]	*pinun hua akai matsi*	leaves
Sanchezia sp. 4 [HOR467]	*pinun hua akai matsi*	leaves
Stenostephanus sp. [HOR455]	*nanpen tsiva*	leaves
Stenostephanus longistaminus (Ruiz & Pav.) V.M.Baum [HOR448]	*xai pei sesepa*	leaves
Streblacanthus sp. [HOR344]	*yametawan taxipa*	leaves
ACHARIACEAE		
Mayna odorata Aubl. [HOR409]	*date mashan*	leaves
ALSTROEMERIACEAE		
Bomarea edulis Herb. [HOR162]	*dei yuxibun bixtu bexea*	leaves
AMARANTHACEAE		
Alternanthera brasiliana (L.) Kuntze [HOR486]	*dau pei taxipa (xan ika maxe)*	leaves
Hebanthe eriantha (Poir.) Pedersen [HOR270]	*xan ika maxe huxupa*	leaves

AMARYLLIDACEAE		
Urceolina cyaneosperma (Meerow) Christenh. & Byng [HOR483]	*dunu huda, anu maspu*	entire plant, exudate
Urceolina sp. 1 [HOR384]	*yawa juda nia (awa huda)*	bulb/corm
Urceolina sp. 2 [HOR366]	*awa huda*	infructescence, bulb/corm
ANACARDIACEAE		
Tapirira aff. *guianensis* Aubl. [HOR259]	*xaen banim*	leaves
ANNONACEAE		
Annona sp.1 [HOR464]	*daya dau*	leaves
Annona sp.2 [HOR407]	*himi kudu xai (kudu xai)*	stem
Annona aff. *ambotay* Aubl. [HOR548]	*daya dau*	leaves
Ephedranthus aff. *guianensis* R.E.Fr. [HOR157]	*nete daewani*	stem
Guatteria aff. *hirsuta* Ruiz & Pav. [HOR065]	*bin hexi*	leaves
Klarobelia pumila Chatrou [HOR537]	*xanin kua xai pei chaxa (baka hatu xai)*	leaves
Mosannona cf. *parva* Chatrou [HOR491]	*baka hatu xai*	leaves
Mosannona aff. *xanthochlora* (Diels) Chatrou [HOR128]	*tama xai*	leaves
Oxandra aff. *longipetala* R.E. Fr. [HOR066]	*yen ikai*	leaves
Pseudomalmea diclina (R.E. Fr.) Chatrou [HOR342]	*tama xai*	leaves
Ruizodendron ovale (Ruiz & Pav.) R.E.Fr. [HOR061]	*kudu xai*	stem
APOCYNACEAE		
Condylocarpon sp. [HOR002]	*madin atsa nixu*	leaves
Fischeria stellata (Vell.) E.Fourn. [HOR101]	*yawa tsis nuin*	leaves
Forsteronia graciloides Woodson [HOR285]	*chaxu nami nuin*	leaves
Lacmellea edulis H. Karst. [HOR181, HOR341]	*hane bata*	leaves

Matelea sp. [HOR273]	*nuin pei dania (nuin pentu) (yawa tsis nuin)*	leaves
Odontadenia sp. [HOR463]	*date punte (chana hina punte)*	leaves
Oxypetalum cf. *flavopurpureum* Goyder & Fontella [HOR549]	*nai benpun*	leaves
Prestonia sp. [HOR556]	*pia beste nuin*	leaves
Tabernaemontana markgrafiana J.F.Macbr. [HOR370]	*xane tsamati*	stem,bark,exudate
unidentified species 01 [HOR011, HOR586]	*dunu maken*	leaves
ARACEAE		
Adelonema wendlandii (Schott) S.Y.Wong & Croat [HOR103]	*xawe dantunku*	leaves
Anthurium atropurpureum var. *arenicola* Croat. [HOR376]	*puatacha (kaya xima)*	leaves
Anthurium brevipedunculatum Madison [HOR026]	*bain tae (isu meken)*	leaves
Anthurium decurrens Poepp. [HOR513]	*huni xanevani*	leaves
Anthurium gracile (Rudge) Schott [HOR512]	*mae xanevani*	leaves
Anthurium kunthii Poepp. [HOR394]	*badi dau*	leaves
Anthurium sagittatum (Sims) G. Don [HOR395]	*xuni pei taxipa (xuni pei tuda)*	leaves
Dracontium spruceanum (Schott) G.H.Zhu [HOR006, HOR250]	*dunun yubin*	entire plant, stem,bulb/corm
Epipremnum pinnatum (L.) Engl. [HOR371, HOR528]	*panin nixpu pei mesi*	stem
Monstera obliqua Miq. [HOR316]	*matsi pei kexka*	leaves
Philodendron aff. *guttiferum* Kunth [HOR099]	*metsi (baxu taka)*	leaves
Philodendron ernestii Engl. [HOR218]	*xuni pei tatxunya*	aerial part
Philodendron exile G. S. Bunting [HOR100]	*baxu taka nishi (upidau pei mesi)*	leaves
Philodendron fibrillosum Poepp. [HOR540]	*in tabi*	leaves
Philodendron paucinervium Croat [HOR301]	*upidau pei ewapabu*	leaves
Philodendron toshibae M. L. Soares & Mayo [HOR110]	*xawe batxii nuin (xuni pei keneya)*	leaves
Philodendron sp.1 [HOR386]	*panin nixpu pei chudi*	leaves
Philodendron sp.2 [HOR508]	*buna tuda*	leaves

Philodendron sp.3 [HOR389]	*xuni pei keneya*	leaves
Stenospermation aff. *andreanum* Engl. [HOR058]	*upi dau pei ewapabu*	leaves
ARALIACEAE		
Didymopanax morototoni (Aubl.) Decne. & Planch. [HOR205]	*yuxin bexmi*	leaves
ARISTOLOCHIACEAE		
Aristolochia aff. *albopilosa* M.González, S.González & Barrie [HOR545]	*kudenka natu*	aerial part
Aristolochia cf. *birostris* Duch. [HOR226]	*bave*	leaves
Aristolochia odoratissima L. [HOR539]	*nai txi wexpa*	aerial part
ASPLENIACEAE		
Asplenium angustum Sw. [HOR116]	*txaxu kexa*	leaves
Asplenium aff. *serra* Langsd. & Fisch. [HOR063]	*yawa pui*	leaves, roots
Asplenium serratum L. [HOR224]	*nuntu tae*	leaves
ASTERACEAE		
Eclipta sp. [HOR297, HOR397]	*manan aku kabia tachunyan*	leaves
Eirmocephala brachiata (Benth.) H. Rob. [HOR543]	*kape txinkan*	leaves
Erigeron bonariensis L. [HOR027] *	*bunkixkun*	leaves
Chromolaena laevigata (Lam.) R. M. King & H. Rob. [HOR029, HOR47]	*bai xaba, aku kabia bai nemakia*	leaves
Mikania leiostachya Benth. [HOR492]	*nuin taxipa*	leaves
Mikania guaco Bonpl. [HOR383]	*xakada himi (xakada istutu peinake)*	leaves
Polyanthina nemorosa (Klatt) R. M. King & H. Rob. [HOR442]	*hene aku kabia*	leaves
Porophyllum ruderale (Jacq.) Cass. [HOR020]*	*nai xaba (inka nai bai)*	leaves

BALANOPHORACEAE		
Helosis cayennensis (Sw.) Spreng. [HOR499]	*mai tu*	leaves
BEGONIACEAE		
Begonia maynensis A.DC. [HOR170, HOR351]	*tetun pei matsi taxipa*	aerial part
Begonia cf. *glabra* Aubl. [HOR581]	*xudu dau*	leaves
Begonia aff. *parviflora* Poepp. & Endl. [HOR398]	*bukun kabia matsi*	leaves
BIGNONIACEAE		
Adenocalymma aff. *impressum* (Rusby) Sandwith [HOR257]	*hanpis dau nixi* (*eska nixi*)	leaves
Adenocalymma sp. [HOR168]	*nixpudun mexupa*	leaves
Arrabidaea sp.1 [HOR022]	*kuin xia* (*yuxinin yushi*) (*yuxinin mani*)	leaves
Arrabidaea sp.2 [HOR053]	*nea dani* (*hanpis dau nishi*)	leaves
Arrabidaea sp.3 [HOR288]	*bunpa pei kudupa* (*himi kudu bunpa)*	leaves
Arrabidaea sp.4 [HOR082]	*kape hatu nenautsi*	bark, roots
Bignonia cf. *lilacina* (A.H.Gentry) L.G.Lohmann [HOR478]	*nuin bakux*	leaves
Callichlamys latifolia (Rich.) K.Schum. [HOR530]	*mukain huxupa bexea*	bark
Cuspidaria floribunda (DC.) A.H.Gentry [HOR177]	*hima nuin*	leaves
Dolichandra uncata (Andrews) L.G.Lohmann [HOR213]	*bunpa mentsisa*	leaves
Dolichandra aff. *unguis-cati* (L.) L.G.Lohmann [HOR056, HOR231, HOR469]	*yuxin bedu nuin* (*yuxin bedu*)	entire plant
Fridericia aff. *florida* (DC.) L.G. Lohmann [HOR571]	*bunpa himiya* (*bunpa pei taxipa*)	leaves
Fridericia japurensis (DC.) L.G.Lohmann [HOR204]	*nuin himi taseya*	leaves
Fridericia cf. *japurensis* (DC.) L.G.Lohmann [HOR073]	*maka huni*	leaves
Fridericia pearcei (Rusby) L.G.Lohmann [HOR544]	*dewe puntusha*	leaves
Jacaranda glabra (DC.) Bureau & K.Schum. [HOR080, HOR211, HOR320]	*chumi maxu*	stem, leaves
Mansoa alliacea (Lam.) A.H.Gentry [HOR353]	*bua itsa*	leaves

Martinella obovata Bureau & K.Schum. [HOR507]	*awa dade*	roots
Parmentiera cereifera Seem. [HOR265]	*binkun* 2 (*mawan pabinki*)	leaves
Tanaecium bilabiatum (Sprague) L.G.Lohmann [HOR583]	*nishi huxu*	leaves
Tanaecium dichotomum (Jacq.) Kaehler & L. G. Lohmann [HOR163]	*inawan madi itsa*	leaves
BIXACEAE		
Bixa orellana L. [HOR589]	*maxe taxipa*	infructescence
BORAGINACEAE		
Cordia nodosa Lam. [HOR446]	*kapa hubu*	bark
Heliotropium verdcourtii Craven [HOR369]	*chudan nuin*	leaves
Myriopus cf. *maculatus* (Jacq.) Feuillet [HOR072]	*nuin pei dania*	leaves
Tournefortia sp. 1 [HOR003]	*xankun nuin (nuin pei huxupa)*	leaves, seeds
Tournefortia sp. 2 [HOR057]	*nuin pentu*	leaves
BURSERACEAE		
Protium cf. *aracouchini* (Aubl.) Marchand [HOR130]	*bawan piai muka*	leaves
Protium goudotianum (Tul.) Byng & Christenh. [HOR578]	*isa hanaken date dau*	leaves
CACTACEAE		
Selenicereus sp. [HOR519]	*kape xau bata*	entire plant
CAMPANULACEAE		
Centropogon cornutus (L.) Druce [HOR377, HOR481]	*Isku xeta bata (xudi batxia)*	leaves

CAPPARACEAE		
Morisonia flexuosa L. [HOR504]	*mana hinis*	bark
Morisonia macrophylla (Kunth) Christenh. & Byng [HOR487]	*awa hatu*	leaves
Morisonia oblongifolia Britton [HOR408]	*make pei dani uma*	leaves
CARDIOPTERIDACEAE		
Citronella sp. [HOR129]	*mai chachi*	leaves
CARYOCARACEAE		
Anthodiscus sp. [HOR500]	*maxi nuin*	leaves
CELASTRACEAE		
Crossopetalum parviflorum (Hemsl.) Lundell [HOR212]	*nixu pei dania*	leaves
Haydenoxylon urbanianum (Loes.) M. P. Simmons [HOR332]	*kuxun xeai tawa (meshudau)*	leaves
Haydenoxylon aff. *urbanianum* (Loes.) M. P. Simmons [HOR044]	*kuxun xeai tawa*	leaves
Hippocratea volubilis L. [HOR192]	*xapu xuntexa*	leaves
Pristimera tenuiflora (Mart. ex Peyr.) A. C. Sm. [HOR142]	*nixi metunya*	stem
CLUSIACEAE		
Chrysochlamys sp. 1 [HOR180]	*xeta xankian matsi*	leaves
Chrysochlamys sp. 2 [HOR207]	*yawa tsis nuin*	leaves
COMBRETACEAE		
Combretum gracile Schott [HOR552]	*yuxi kabia nena utsi*	leaves
Combretum cf. *llewelynii* J. F. Macbr. [HOR186]	*make pei dani uma*	leaves
Combretum sp. [HOR021]	*paka tapun mecha (yawa huda)*	leaves

COMMELINACEAE		
Commelina rufipes Seub. [HOR462]	*bunkixkun bata*	leaves
Dichorisandra hexandra (Aubl.) Standl. [HOR040, HOR155]	*yawa juda bexea* (*mai dunu nuseken)*	leaves
Floscopa aff. *peruviana* Hassk. ex C.B.Clarke [HOR390]	*yawa siu pei chudi bexea*	leaves
Geogenanthus poeppigii (Miq.) Faden [HOR281]	*tunun sese*	entire plant
Tradescantia zanonia (L.) Sw. [HOR317, HOR429]	*txaxu bake bixtun* (*bake bixtun*)	bark
Tradescantia zebrina Bosse [HOR019]	*txaxu bake bixtun*	leaves
CONNARACEAE		
Connarus punctatus Planch. [HOR503, HOR199]	*tene kabia nenautsi (anu xaxe)*	bark
Connarus cf. *punctatus* Planch. [HOR531]	*mukain nia mexupa*	leaves
Rourea amazonica (Baker) Radlk. [HOR287]	*Nenautsi himiya (tene kabia nenautsi)*	bark
CONVOLVULACEAE		
Calycobolus sp. [HOR430]	*baka xaka*	leaves
Ipomoea aff. *bernoulliana* Peter [HOR420]	*batata*	bulb/corm
COSTACEAE		
Costus spiralis (Jacq.) Roscoe [HOR165]	*bunkax matsi*	leaves
Costus sp. 2 [HOR164]	*bunkax matsi*	leaves
CUCURBITACEAE		
Gurania sp. 1 [HOR535]	*xani xupan*	leaves
Gurania sp. 2 [HOR274]	*xani xupan*	leaves

CYCLANTHACEAE		
Asplundia acuminata (Ruiz & Pav.) Harling [HOR147]	*chaxun bume*	leaves
CYPERACEAE		
Rhynchospora umbraticola Poepp. & Kunth [HOR097, HOR396]	*kamanen xaxi*	leaves
DIOSCOREACEAE		
Dioscorea acanthogene Rusby [HOR243]	*dantan ikan hina*	leaves
Dioscorea cf. *acanthogene* Rusby [HOR340]	*dantan ikan hina*	leaves
Dioscorea sp. 1 [HOR220]	*dantan ikan hina*	leaves
Dioscorea sp. 2 [HOR235]	*xave tepun nenautsi*	leaves
Dioscorea sp. 3 [HOR461]	*tatun muxa pei sesepa*	entire plant
ELAEOCARPACEAE		
Sloanea garckeana K.Schum. [HOR576]	*xuku dau (xaka dau)*	leaves
Sloanea guianensis (Aubl.) Benth. [HOR127]	*maxan manvan*	leaves
EUPHORBIACEAE		
Acalypha diversifolia Jacq. [HOR424]	*ishish munuan* (*xabunman dakati*)	leaves
Acalypha schiedeana Schltdl. [HOR182]	*ni bakis huxupa* (*xabunman dakati*)	leaves
Adenophaedra megalophylla (Müll.Arg.) Müll.Arg. [HOR515]	*dukan upi dau*	leaves
Alchornea cf. *costaricensis* Pax & K.Hoffm. [HOR017]	*xeins*	leaves
Alchorneopsis floribunda (Benth.) Müll.Arg. [HOR043, HOR113]	*kapan yankanti*	leaves
Croton cuneatus Klotzch [HOR558]	*xena iti*	leaves
Euphorbia aff. *hirta* L. [HOR477]	*isa hana bedu*	exudates
Mabea cf. *nitida* Spruce ex Benth. [HOR498]	*isu huda*	leaves

Manihot brachyloba Müll.Arg. [HOR493]	*dua pei*	leaves
Sapium glandulosum (L.) Morong [HOR284]	*pinubiniwan*	leaves
FABACEAE		
Andira cf. *multistipula* Ducke [HOR364]	*bunpa himiya nia*	bark
Clitoria amazonum Mart. ex Benth. [HOR433]	*nenautsi xankuma*	leaves
Clitoria pozuzoensis J.F.Macbr. [HOR432]*	*nenautsi himiya (tene kabia nenautsi)*	bark, roots
Clitoria sp.1 [HOR076]	*kuman nishi*	leaves
Clitoria sp.2 [HOR516]	*kuman maxu*	leaves
Desmodium axillare (Sw.) DC. [HOR054]	*shanu tamu nenautsi*	leaves
Desmodium aff. *rhynchodesmum* (S.F.Blake) Standl. [HOR045]	*yuxu kabia bata*	leaves
Erythrina ulei Harms [HOR023]	*kaxu*	bark
Fairchildia sp. [HOR077]	*awa punu nenautsi*	leaves
Machaerium arboreum (Jacq.) Vog. [HOR001]	*dunun yuxu nia*	leaves
Machaerium cuspidatum Kuhlm. & Hoehne [HOR122, HOR174]	*kapa xeta nenautsi*	leaves
Machaerium floribundum Benth. [HOR466]	*pupu dani*	leaves
Ormosia sp. [HOR078]	*nenautsi himiya*	bark
Phaseolus coccineus L. [HOR078]	*yuxu kabia bata* (*yuxu kabia*)	leaves
Senna aff. *hirsuta* (L.) H.S.Irwin & Barneby [HOR588]	*xaxadau*	leaves
Schnella hirsutissima (Wunderlin) Trethowan & R.Clark [HOR246, HOR587]	*nixi pei dania* (*awa benen be pasa nixi*)	entire plant
Schnella aff. *guianensis* (Aubl.) Wunderlin [HOR580]	*nixpudun xebiya, hinaya*	stem
Schnella cf. *guianensis* (Aubl.) Wunderlin [HOR443]	*utatanwan taxipa*	leaves
Swartzia sp. [HOR035]	*xaen banim*	leaves
GESNERIACEAE		
Achimenes sp. [HOR476]	*nanpen tsiva* 4	leaves

Drymonia tenuis (Benth.) J.L.Clark [HOR153, HOR189, HOR336, HOR380]	*nuin hene watima*	leaves
Drymonia teuscheri (Raymond) J.L.Clark [HOR118, HOR169]	*xan ikapan maxe*	leaves
Drymonia coccinea (Aubl.) Wiehler [HOR064]	*xuke txixin bata*	leaves
Gloxinia perennis Fritsch [HOR064]	*samum txixini xudu dau*	entire plant
Nautilocalyx bullatus (Lem.) Sprague [HOR438]	*himi kains*	leaves
Nautilocalyx pallidus Sprague [HOR280]	*txatxa matsi* (*awa himi xudu dau*)	leaves
Nautilocalyx sp. [HOR092]	*chaxu bexiwa xudu dau*	leaves
Odontonema aff. *callistachyum* (Schltdl. & Cham.) Kuntze [HOR037]	*manan aku kabia tachunyan*	leaves
HYPERICACEAE		
Vismia glabra Ruiz & Pav. [HOR551]	*kaya xaba*	leaves
CHRYSOBALANACEAE		
Acioa dolichopoda (Prance) Sothers & Prance [HOR290]	*chachi dau*	leaves
Couepia obovata Ducke [HOR258]	*xinu inin*	stem
Hymenopus arachnoideus (Fanshawe & Maguire) Sothers & Prance [HOR214]	*nixu pei dani uma nia*	leaves
ICACINACEAE		
Leretia cordata Vell. [HOR532]	*mai txatxituxpi dau*	roots
LACISTEMATACEAE		
Lacistema aggregatum (P.J.Bergius) Rusby [HOR176, HOR559]	*xane tenan metxa* (*xai ewaisma*)	leaves
LAMIACEAE		
Aegiphila cordata Poepp. [HOR120, HOR315]	*make pei dania*	leaves
Aegiphila cuneata Moldenke [HOR140, HOR196, HOR331, HOR485]*	*kunubin kabia*	bark

Aegiphila verticillata Vell. [HOR028]	*dumenvan*	leaves
Cantinoa aff. *althaeifolia* (Pohl ex Benth.) Harley & J.F.B.Pastore [HOR071	*xanenatu* (*asti daun*)	leaves
Hyptis capitata Jacq. [HOR311]	*machan bimi* (*mapis*)	leaves
Ocimum sp. [HOR574]	*buxku isin dau pei ewapabu*	leaves
Coleus amboinicus Lour. [HOR585]	*mauja* 2 (*kadiun yuna dau*)	leaves
Coleus barbatus (Andrews) Benth. ex G.Don [HOR584]	*mauja* 1	leaves
Scutellaria coccinea Kunth. [HOR015, HOR089, HOR293]	*tama kabia bata*	leaves
LAURACEAE		
Aniba sp.1 [HOR237]	*buxun maxu*	leaves
Aniba sp.2 [HOR292]	*pitsun bata*	leaves
Cinnamomum sp. [HOR115]	*hasim pestudu yunu bata*	leaves
Endlicheria cf. *dysodantha* (Ruiz & Pav.) Mez [HOR538]*	*xane hainx kuni yunu*	leaves
indet. sp. [HOR210]	*dunuanen upidau*	leaves
Nectandra sp. [HOR221]	*sada dau*	leaves
Ocotea leptobotra (Ruiz & Pav.) Mez [HOR062]	*hasim pestudus yunu*	leaves
Ocotea sp.1 [HOR434]	*kudu dau yunu*	bark
Ocotea sp.2 [HOR582]	*xinu hina yunu*	leaves
LINDSAEACEAE		
Lindsaea cf. *lancea* (L.) Bedd. [HOR402]	*xaku chiva pei mesi*	leaves
LOGANIACEAE		
Strychnos brachiata Ruiz & Pav. [HOR081]	*isu metse*	leaves
Strychnos schunkei Krukoff & Barneby [HOR166]	*nuchun tun*	stem
Strychnos tarapotensis Sprague & Sandwith [HOR013, HOR161]*	*nuchun tun* (*isu metse*)	leaves

MALPIGHIACEAE		
Banisteriopsis caapi (Spruce ex Griseb.) C.V.Morton [HOR524]	*nixi pae* (*ayahuasca*)	stem, bark
Banisteriopsis aff. *caapi* (Spruce ex Griseb.) C.V.Morton [HOR038]	*navanti kudu*	leaves
Bunchosia armeniaca (Cav.) DC. [HOR264]	*make pei dani uma*	leaves
Bunchosia sp. [HOR452]	*nixi bata*	leaves
Diplopterys cf. *erianthera* (A.Juss.) W.R.Anderson & C.Davis [HOR468]	*make pei dani uma*	leaves
Hiraea fagifolia (DC.) A.Juss. [HOR326]	*xeta xankin matsi*	leaves
Hiraea cf. *fagifolia* (DC.) A.Juss. [HOR195]	*xawan maxka bunpa*	leaves
Hiraea faginea (Sw.) Nied. [HOR197, HOR335]	*kapa buxka*	leaves
Hiraea grandifolia Standl. & L.O.Williams [HOR206]	*xane tsamati*	bark, roots
Hiraea cf. *reclinata* Jacq. [HOR542]	*batuman piti* (*chaxun bume*)	leaves
Mascagnia eggersiana (Nied.) W.R.Anderson [HOR172]	*nixi bata pei txumi*	leaves
Mascagnia eggersiana (Nied.) W.R.Anderson [HOR289]	*utatanwan*	leaves
Stigmaphyllon aff. *adenodon* A.Juss. [HOR075]	*haxuman huni* (*yuxin bexmi*)	bark, roots
MALVACEAE		
Abutilon sp. [HOR526. HOR 536]	*xuya hina nixi*	leaves
Eriotheca globosa (Aubl.) A.Robyns [HOR564]	*nuniwan*	leaves
Guazuma crinita Mart. [HOR191]	*patxa kaman kenan*	leaves
Hibiscus acetosella Welw. ex Hiern [HOR570]	*malva taxipa*	leaves
Herrania balaensis H.Preuss [HOR225]	*nesan paubin*	leaves
Malachra alceifolia Jacq. [HOR566]	*malva* (*redondo*)	leaves
Malachra ruderalis Gürke [HOR573]	*malva* (*cetico*)	leaves
Pavonia fruticosa (Mill.) Fawc. & Rendle [HOR114]	*tudu padada*	leaves
Quararibea wittii K.Schum. & Ulbr. [HOR431]	*tui pei*	leaves
Theobroma cacao L. [HOR427]	*chaxun dexan* (*cacao*)	leaves

Matisia cordata Bonpl. [HOR422]	*ixtxibin* (*zapote*)	leaves
MARANTHACEAE		
Goeppertia contrafenestra (H.Kenn.) Borchs. & S.Suárez [HOR425]	*mani pei keneya* 1	leaves
Goeppertia picturata (K.Koch & Linden) Borchs. & S.Suárez [HOR167]	*mani pei taxipa xiwaya*	leaves
Goeppertia sanderiana (Sander) Borchs. & S.Suárez [HOR450]	*mani pei keneya* 2	leaves
Goeppertia standleyi (J.F.Macbr.) Borchs. & S.Suárez [HOR445]*	*tsau mani*	stem
indet. sp. [HOR546]	*mani pei bai kudu*	leaves
MARCGRAVIACEAE		
Marcgravia sp. [HOR275]	*yen ika*	leaves
MELASTOMATACEAE		
Miconia elegans Cogn. [HOR108]	*Binkun* 1	leaves
Miconia sulcicaulis (Poepp. ex Naudin) Ocampo & Almeda [HOR419]	*binkun* 3 (*xete mapu*)	leaves
MELIACEAE		
Guarea pterorhachis Harms [HOR358]*	*yapa pawan*	leaves
Trichilia quadrijuga Kunth [HOR495]	*anun buna dau*	leaves
Trichilia singularis C. DC. [HOR557]	*kuma tae yapa* (*yapa mexiupa*)	leaves
MENISPERMACEAE		
Abuta grandifolia (Mart.) Sandwith [HOR229]*	*kanapan binu*	bark, leaves
Cissampelos cf. *laxiflora* Moldenke [HOR413]	*naumin*	aerial part
Elissarrhena longipes Miers [HOR133, HOR286]	*isun betun iti*	leaves
Chondrodendron tomentosum Ruiz & Pav. [HOR119, HOR436]	*awa teux muka*	bark, roots

MONIMIACEAE		
Mollinedia ovata Ruiz & Pav. [HOR560]	*heu sasa*	leaves
MORACEAE		
Brosimum guianense (Aubl.) Huber ex Ducke [HOR159, HOR565]	*xana pawan*	leaves
Ficus gomelleira Kunth & C.D.Bouché [HOR194]	*yumen pei*	leaves
moraceae (continued)		
Maclura tinctoria (L.) D.Don ex G.Don [HOR187, HOR333]	*kuxun huda*	leaves
MYRISTICACEAE		
Virola duckei A.C.Sm. [HOR252]	*kuxun xeai tawa nixu*	leaves
Virola cf. *minutiflora* Ducke [HOR150]	*tava nixu*	leaves
MYRTACEAE		
Myrcia hylobates (Standl. ex Amshoff) E.Lucas & K.Samra [HOR525]*	*amen tedeku*	leaves
Campomanesia speciosa (Diels) McVaugh [HOR525]	*xanchu kume* (*xanchu kemu*)	leaves
Eugenia florida DC. [HOR255, HOR345, HOR435]	*awa huinti* (*awa huinti dunu maken*)	leaves
Eugenia moschata (Aubl.) Nied. ex T.Durand & B.D.Jacks. [HOR068, HOR534]	*yapa yapa* (*yapa bedu waa*)	leaves
Myrcia densiflora (Poepp. ex O.Berg) A.R.Lourenço & E.Lucas [HOR093]	*mani yuxin*	leaves
Myrcia lonchophylla A.R.Lourenço & E.Lucas [HOR136]	*kankan takanpi*	leaves
Myrcia cf. *simulata* (McVaugh) A.R.Lourenço & Parra-Os. [HOR482]	*anun buna dau*	leaves
Myrcia sp.1 [HOR459]	*piti mixan* (*piti katsankupia bunpa*)	leaves
Myrcia sp.2 [HOR520]	*hasiman pini dau*	leaves
Myrcia sp.3 [HOR405]	*mankan huinti*	leaves
Myrciaria floribunda (H.West ex Willd.) O.Berg [HOR362, HOR454, HOR509]	*basan hanpin, dunun maxe bushudi*	leaves

NYCTAGINACEAE		
Neea divaricata Poepp. & Endl. [HOR042, HOR263, HOR329, HOR518]	*kuxun himi* (*txutxtiwan*, *txuxti*)	infructescence
Neea aff. *floribunda* Poepp. & Endl. [HOR203]	*chaxu nami nuin bexea*	leaves
Neea spruceana Heimerl [HOR096]	*txutxtiwan*	leaves
Neea verticillata Ruiz & Pav. [HOR323]	*chaxu nami nuin*	leaves
Neea aff. verticillata Ruiz & Pav. [HOR563]	*pui takex*	leaves
OLACACEAE		
Heisteria acuminata (Bonpl.) Engl. [HOR094]	*pitsun bata*	roots
Heisteria cf. *concinna* Standl. [HOR014]	*chachidau xukuya*	leaves
ORCHIDACEAE		
Cycnoches haagii Barb.Rodr. [HOR423]	*xeu pei* (tamshi)	leaves
Dracula sp. [HOR399]	*amitsa* 2 *(bani amitsa aka hibinetamea)*	leaves
Erycina pusilla (L.) N.H.Williams & M.W.Chase [HOR272]	*nava meken*	entire plant
Govenia sp. [HOR415]	*dunu huda* (*anu maspu*)	entire plant
Masdevallia pandurilabia C.Schweinf. [HOR349]	*amitsa* 1	leaves
indet. sp. [HOR276]	*hi binetame pusiya*	entire plant
OXALIDACEAE		
Oxalis leptopodes G. Don [HOR232]*	*tete bexmi*	leaves
PASSIFLORACEAE		
Passiflora araujoi Sacco [HOR091]	*nai tatxa*	leaves
Passiflora cf. *nítida* Kunth [HOR256]	*kuin xia*	leaves
Passiflora quadriglandulosa Rodschied [HOR253]	*nai tatxa*	entire plant
Passiflora sp. [HOR457]	*yuxin beste*	roots

PEDALIACEAE		
Sesamum indicum L. [HOR553]	*xixibin*	seeds
PETIVERIACEAE		
Hilleria secunda (Ruiz & Pav.) Kuntze [HOR428]	*navanti kudu* (*mais xeta*)	aerial part
Petiveria alliacea L. [HOR201]	*yawa katsian*	roots
PHYLLANTHACEAE		
Croizatia sp. nov. [HOR527]	*chaxu nami nuien tsaka nia*	leaves
PIPERACEAE		
Peperomia cf. *blephariphylla* Trel. & Yunck. [HOR359]	*hisis kue* (*kuni pabinki*)	leaves
Peperomia pilosa Ruiz & Pav. [HOR123, HOR282, HOR308]	*madi chibudux*	entire plant
Peperomia cf. *swartziana* Miq. [HOR330]	*bunpa pei chudi*	entire plant
piperaceae (continued)		
Piper aduncum L. [HOR074, HOR084, HOR245, HOR474]	*nava maxkini*	roots, bark
Piper aequale Vahl [HOR414]	*badin pakex matsi*	leaves
Piper callosum Ruiz & Pav. [HOR085]	*xakapan dade*	leaves
Piper casapiense (Miq.) C.DC. [HOR107]	*awa denpan nixpu*	leaves
Piper costatum C.DC. [HOR088, HOR437]	*babu dau*	leaves
Piper heterophyllum Ruiz & Pav. [HOR222]	*bixta kuma katsis*	leaves
Piper hispidum Sw. [HOR183, HOR475]	*xawan hina nixpu* (*bexa nixpu*)	stem
Piper laevigatum Kunth [HOR069]	*awadan date dau*	leaves
Piper cf. *lanceolatum* Ruiz & Pav. [HOR051]	*matsi pei tadunua*	leaves
Piper nudilimbum C.DC. [HOR095, HOR328]*	*yaix maxaka*	
Piper aff. *marginatum* Jacq. [HOR012, HOR299]	*nidu buxka matsi*	leaves

Piper peltatum L. [HOR379]*	*chexen pei*	leaves
Piper reticulatum L. [HOR102, HOR217, HOR57]	*chichan pei* (*hedekan bepute*)	leaves
Piper sp.1 [HOR440]	*nixpu kayabi* (*texnixpu*)	stem
Piper sp.2 [HOR032]	*badin pakex* (*chana chixin yametanwan*)	leaves
Piper sp.3 [HOR190]	*xia nixpu* (*bata itsa itsa ikai*)	stem
Piper sp.4 [HOR354]	*babu dau pei ewapabu*	leaves
Piper sp.5 [HOR387]	*bawa deshin hana*	leaves
Piper sp.6 [HOR517]	*uxa dau*	leaves
Piper sp.7 [HOR555]	*inkan bia*	leaves
Piper sp.8 [HOR561]	*paka nixpu hawen pei xupu*	leaves
Piper sp.9 [HOR247]	*nixpu pei*	leaves
POLYGALACEAE		
Bredemeyera sp. [HOR291]	*yawa huda* (*chimapun kupia*)	leaves
Caamembeca gigantea (Chodat) J.F.B.Pastore [HOR202]*	*bata pei dentupa*	leaves
Caamembeca spectabilis (DC.) J.F.B. Pastore [HOR294]	*bata pei dentupa*	leaves
POLYPODIACEAE		
Campyloneurum aphanophlebium (Kunze) T.Moore [HOR307]	*tsanas kate*	leaves
Cyclopeltis semicordata (Sw.) J. Sm. [HOR470]	*xaku chiva maxkaya*	leaves
Mickelia aff. *guianensis* (Aubl.) R. C. Moran, Labiak & Sundue [HOR109]	*yawa pui*	leaves, roots
Phlebodium decumanum (Willd.) J.Sm. [HOR352]	*nuntu xau*	stem
POTTIACEAE		
Didymodon sp. [HOR410]	*disi chuka*	entire plant

PRIMULACEAE		
Ardisia pellucida Oerst. [HOR267]	*xawanen dade*	entire plant
Clavija nutans (Vell.) B. Ståhl [HOR151, HOR145]	*maspanewan*	leaves
Clavija weberbaueri Mez. [HOR111, HOR298, HOR236]	*maspanewan*	leaves
Stylogyne aff. *ardisioides* (Kunth) Mez [HOR148]	*yen ika*	leaves
PTERIDACEAE		
Adiantum platyphyllum Sw. [HOR393]	*xanchu xeta nenautsi*	leaves
Adiantum poeppigianum C.Presl [HOR149, HOR173]	*dunu buxka nenautsi*	leaves
Pityrogramma calomelanos (L.) Link [HOR215, HOR417, HOR569]	*bai kudu*	aerial part
RHAMNACEAE		
Gouania sp. [HOR480]	*nai tacha*	entire plant
Sarcomphalus aff. *cinnamomum* (Triana & Planch.) Hauenschild [HOR171]	*pinu hana muxa*	leaves
ROSACEAE		
Prunus myrtifolia (L.) Urb. [HOR158]	*biunx jaxu*	leaves
RUBIACEAE		
Calycophyllum spruceanum (Benth.) Hook.f. ex K.Schum. [HOR494]	*axu* (*capirona*)	bark
Coussarea sp. [HOR577]	*dunu nami mecha*	leaves
Faramea multiflora A.Rich. ex DC. [HOR541]	*xane tsamatininwan*	leaves
Geophila macropoda (Ruiz & Pav.) DC. [HOR025, HOR302]*	*xuniwan*	leaves
Hamelia axillaris Sw. [HOR312]	*xawan himi*	leaves
Hamelia patens Jacq. [HOR031, HOR567]	*maxe istubin nia* (*xawan himi*)	leaves
Chomelia aff. *pubescens* Cham. & Schltdl. [HOR152]	*nuchun tun*	stem
Palicourea deflexa (DC.) Borhidi [HOR052]	*punu txi waa dau*	entire plant

Palicourea aff. *deflexa* (DC.) Borhidi [HOR347, HOR360]	*sanim bachi*	leaves
Palicourea racemosa (Aubl.) G.Nicholson [HOR501]	*ipu bachi*	leaves
Pentagonia amazonica (Ducke) L.Andersson & Rova [HOR104, HOR426]	*nanewan*	bark, infructescence
Pentagonia macrophylla Benth. [HOR156]	*nanewan*	bark
Pentagonia sp. [HOR262]	*nanewan*	leaves
Psychotria alba Ruiz & Pav. [HOR248]	*matsi kawa*	leaves
Psychotria cf. *carthagenensis* Jacq. [HOR363]*	*matsi kawa*	leaves
Psychotria ruizii Standl. [HOR178]	*dei yuxibun bixtu nia*	leaves
Psychotria viridis Ruiz & Pav. [HOR521]*	*kawa*	leaves
Psychotria sp.1 [HOR533]	*yametawan huxupa*	leaves
Psychotria sp.2 [HOR554]	*inu kemu* (*bina matian*)	leaves
Psychotria sp.3 [HOR382]	*kawa*	leaves
Randia armata (Sw.) DC. [HOR018, HOR146, HOR175]*	*ixkin tepekan bata*	leaves
Rosenbergiodendron longiflorum (Ruiz & Pav.) Fagerl. [HOR004, HOR401]	*besti bata*	leaves
Uncaria tomentosa (Willd. ex Schult.) DC. [HOR240, HOR510, HOR529, HOR568]	*mae muxa*	bark, stem
RUTACEAE		
Esenbeckia febrifuga A.Juss. [HOR185]	*chaki*	leaves
Zanthoxylum caribaeum Lam. [HOR254, HOR239]	*bata itsa itsa ikai* (*kutan dau*)	aerial part
Zanthoxylum aff. *setulosum* P.Wilson [HOR039]	*kutan dau*	stem
Zanthoxylum sp. [HOR193]	*ixchinantiwa, puinki hane*	leaves
SALICACEAE		
Casearia aff. *guianensis* (Aubl.) Urb. [HOR144]	*xipin tun akai bata*	leaves
Casearia obovalis Poepp. ex Griseb. [HOR249, HOR343]	*xipin tun akai bata*	bark
Casearia sylvestris Sw. [HOR050]	*xipin tun akai bata*	leaves

Casearia sp.1 [HOR036]	*nete daewani* (*yamechana*)	leaves
Casearia sp.2 [HOR044]	*xanetenan mecha*	leaves
Casearia sp.3 [HOR266]	*xipin tun akai bata*	stem, bark
Lunania parviflora Spruce ex Benth. [HOR059, HOR121, HOR137, HOR314]	*astuai bata*	bark
Xylosma tessmannii Sleumer [HOR184, HOR223]	*inu kexni*	bark
Xylosma velutina (Tul.) Triana & Planch. [HOR125]	*hi muxaya* (*tunun huda*)	leaves
SAPINDACEAE		
Allophylus leucoclados Radlk. [HOR388]	*xinu inin*	leaves
Cardiospermum halicacabum L. [HOR378]	*mai matsi*	aerial part
Paullinia alata (Ruiz & Pav.) G.Don [HOR403]	*ainbun mixan*	leaves
Paullinia aff. *alata* (Ruiz & Pav.) G.Don [HOR134]	*du dani tese dau* (*napapax*)	leaves
Paullinia cf. *alata* (Ruiz & Pav.) G.Don [HOR131]	*bunpa xukuya*	leaves
Paullinia anomophylla Radlk. [HOR338]	*xawan maxka bunpa*	leaves
Paullinia cf. *dasystachya* Radlk. [HOR138, HOR506]	*inu dani bunpa*	leaves
Paullinia killipii J.F. Macbr. [HOR406, HOR441]	*xawe pui* (*kadan ba*)	bark
Paullinia pinnata L. [HOR505]	*bunpa tachunyan*	roots
Paullinia tenera Poepp. & Endl. [HOR016]	*hasim punu nenautsi*	leaves
Serjania sp. [HOR034]	*bakan bia*	leaves
Talisia cf. *sylvatica* (Aubl.) Radlk. [HOR562]	*kespin xanichin nenautsi*	bark
SAPOTACEAE		
Pouteria sp. [HOR453]	*kana yuchi*	leaves
SELAGINELLACEAE		
Selaginella cf. *martensii* Spring. [HOR324]	*huinti mexpun*	entire plant

SCHIZAEACEAE		
Lygodium venustum Sw. [HOR126, hor238]	*xaku chiva nenautsi*	leaves
SIPARUNACEAE		
Siparuna cervicornis Perkins [HOR124]	*yuxin bia*	leaves
Siparuna aff. *subinodora* (Ruiz & Pav.) A.DC. [HOR106]	*yuxin bia*	leaves
SMILACACEAE		
Smilax cf. *domingensis* Willd. [HOR497]	*tatun muxa pei sese*	leaves
Smilax purhampuy Ruiz [HOR188]	*dantan ika hina*	leaves
SOLANACEAE		
Brunfelsia grandiflora D.Don [HOR070, HOR268]	*manan aku kabia*	leaves, roots
Brunfelsia sp. [HOR350]	*aku kabia*	leaves
Cestrum reflexum Sendtn. [HOR318, HOR373]*	*paka tapun mecha*	leaves
Cestrum schlechtendalii G. Don [HOR234, HOR449]	*awa pui* (*bixta kuma katsis*)	leaves
Lycianthes coffeifolia Bitter [HOR411, HOR502]	*bata hanaya*	leaves
Lycianthes inaequilatera (Rusby) Bitter [HOR060, HOR090, HOR135, HOR279]	*texkan bata*	leaves
Solanum arboreum Humb. & Bonpl. ex Dunal [HOR227, HOR458]	*xeki nue (kawa pese)*	bark
Solanum barbeyanum Huber [HOR439]	*i txiux 2*	infructescence
Solanum cf. *mite* Ruiz & Pav. [HOR049, HOR319]	*utsi bata taxipa*	leaves
Solanum nemorense Dunal [HOR251]*	*i chiux*	infructescence
Solanum oppositifolium Ruiz & Pav. [HOR374]	*kamuxun bata*	leaves
Solanum sessile Ruiz & Pav. [HOR010, HOR244]*	*xau bata dau*	aerial part, bark
Solanum thelopodium Sendtn. [HOR208, HOR303]	*kamuxun bata*	leaves
Solanum sp. 1 [HOR048, HOR337]	*utsi bata juxupa*	leaves

Solanum sp. 2 [HOR141]	*xankun nuin (nuin pei juxupa)*	leaves
Solanum sp. 4 [HOR381]	*i chiux 1*	leaves
TECTARIACEAE		
Tectaria antioquiana C. Chr. [HOR579]	*xaku chiva maxkaya*	leaves
Tectaria pilosa (Fée) R. C. Moran [HOR550]	*xaku chiva pei ewapabu*	leaves
URTICACEAE		
Pilea bassleriana Killip [HOR444]	*binkun* 4	leaves
Urera lianoides A. K. Monro & Al.Rodr. [HOR490]	*xabuman dakati*	leaves
VERBENACEAE		
Bouchea fluminensis (Vell.) Moldenke [HOR233]	*chi bata*	leaves
Lantana camara L. [HOR024]	*mapis*	leaves
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson [HOR572]	*midis*	leaves
VIOLACEAE		
Leonia glycycarpa Ruiz & Pav. [HOR041, HOR260, HOR391]*	*tunku dau bata*	bark,stem
Rinorea cf. *camptoneura* (Radlk.) Melch. [HOR055]	*xani kaxa*	leaves
Rinorea lindeniana (Tul.) Kuntze [HOR375]	*awa tae shiwen*	bark
Rinorea aff. *lindeniana* (Tul.) Kuntze [HOR514]*	*xinven*	stem
Rinorea sp. [HOR327]	*xani kaxa*	leaves
VITACEAE		
Cissus sp. [HOR404]	*baka kunabu*	leaves
Vitis amazonica (Linden) G.Nicholson [HOR496, HOR160]	*nai nishi taxipa*	leaves

ZAMIACEAE		
Zamia ulei Dammer [HOR392, HOR489]*	*yuxinen mani*	roots,leaves
ZINGIBERACEAE		
Renealmia breviscapa (Poepp. & Endl.) Poepp. & Endl. [HOR523]	*itsami*	leaves

List of indeterminable species

unknown sp. 1 [HOR209]	*xakada himi*	leaves
unknown sp. 2 [HOR216]	*manan yukan*	leaves
unknown sp. 3 [HOR228]	*nuin xukuya*	bark
unknown sp. 4 [HOR230]	*xanchu kume*	leaves
unknown sp. 5 [HOR261]	*xixi itsa*	leaves
unknown sp. 6 [HOR271]	*kapan chi*	leaves
unknown sp. 7 [HOR304]	*yuxin bedu*	leaves
unknown sp. 8 [HOR321]	*mani yuxin*	leaves
unknown sp. 9 [HOR322]	*nanpen tsiva*	leaves
unknown sp.10 [HOR465]	*binkun*	leaves
unknown sp.11 [HOR479]	*tsunu maxu*	leaves
unknown sp.12 [HOR590]	*pupu tae*	leaves

Appendix 2: The list of 79 neglected medicinal plants

Table A2 79 Cashinahua medicinal species unreported or rarely cited for medicinal use or phytochemical analysis and their traditional uses

Plant species, voucher specimen, family and life form*	**Vernacular name(s)***	**Plant part(s) used**	**Popular use (indications)**	**Preparation (administration)#**	**FC‡ (n = 20)**
Adiantum poeppigianum C. Presl Hor 149 PTERIDACEAE herb	*xantxu xeta nenautsi, dunu buxka nenautsi*	Leaf	Digestive problems	Soaked (I, ingestion)	1
			Menstrual pains	Decoction (E, wash)	1
			Injuries	Chewed up (E, squeeze in the afected part)	13
			Inflamed wound	Ground/pounded (E, plaster) Decoction (E, wash)	12
			Snakebite (*tada kamakia*)	Ground/pounded (E, squeeze in the afected part), decoction (E, wash)	8
			Abortificient	Squeezed (I, ingestion)	11
Aegiphila cuneata Moldenke Hor 140 LAMIACEAE herb	*kunubin kabia*	Leaf	Leishmaniosis	Chewed up material or Patarashca* (E, squeeze in the afected part)	12
		Leaf, stem bark	Poisoning (spider bites)	Pounded (E, squeeze in the afected part)	2

Aphelandra acrensis Lindau Hor 087 ACANTHACEAE (sub)shrub	*yame bebe*	Leaf	Dizzines	Decoction (E, warm bath)	11
			Nightmares	Decoction (E, cold bath)	3
			Facial palsy	Soaked (E, cold wash)	14
Aphelandra caput-medusae Lindau Hor 079 ACANTHACEAE (sub)shrub	*basikun bexiwa*	Leaf	Fainting	Decoction (E, warm bath)	10
Aphelandra lasiandra (Mildbr.) McDade & E.A.Tripp. Hor 112 ACANTHACEAE shrub	*yawan kuxi dau* *yawan kuxi dau bata* *yawan xuke dau* *txikix payati matsi*	Entire plant	Muscle stimulant	Soaked (E, cold bath)	12
		Leaves	Seizures, epilepsy of *yawa*	Decoction (E, warm bath)	14
			Venomous bite *awawa*-*Scolopendra gigantea*	Chewed or pounded (E, direct application)	2
			Headache	Pounded (E, wash)	2
				Soaked (E, wash)	3
			Insomnia, nightmare	Squeezed (E, eye drops)	2
Aristolochia odoratissima L. Hor 539 ARISTOLOCHIACEAE climber	*nai txi wexpa*	Leaves	Vomiting	Decoction (E, warm bath)	2
		Aerial parts			
			Newborn diarrhea	Decoction (E, warm bath)	2
			Fainting	Decoction (E, warm bath)	9

Asplenium angustum Sw. Hor 116 ASPLENIACEAE epiphyte	*txaxu kexa*	Leaves	Sores	Patarashca* (E, mouth washes, I ingestion)	13
Asplenium serratum L. Hor 224 ASPLENIACEAE epiphyte	*nuntu tae*	Leaves	Gallbladder disorders	Heated up (E, cataplasma)	2
			Gallbladder, cirrhosis	Heated up (E, cataplasma)	3
			Tumor	Heated up (E, cataplasma)	3
			Pain	Heated up (E, cataplasma)	9
			Canker sores	Patarashca* (E, squeeze in the afected part),	1
Begonia maynensis A. DC. Hor 170 BEGONIACEAE herb	*tetun pei matsi taxipa*	Leaves	Treats all diseases	Soaked (I, ingestion)	1
			Upset stomach	Soaked (I, ingestion)	4
			Gallbladder, liver	Soaked (I, ingestion)	2
			Ovary, kidney	Decoction (E, warm bath)	2
			Hyperthermia	Soaked (E, cold bath)	2
			Chills, tremor	Decoction (E, warm bath)	3
			Facial palsy	Soaked (E, friction)	1
			Snakebite *shanu*	Soaked (E, friction)	5
			Bronquitis	Soaked (I, ingestion)	10
Bomarea edulis (Tussac) Herb. Hor 162 ALSTROEMERIACEAE herb	*dei yuxibun bixtu bexea*	Leaves	Tranquilliser	Decoction (E, warm bath)	4
			Facial palsy	Soaked (E, local wash, friction)	18

Casearia obovalis Poepp. ex Griseb. Hor 249 SALICACEAE shrub/tree	*xipintun akai bata*	Leaves	Boils	Heated up (E, cataplasm)	1
		Stem bark	Groin hernia	Soaked (E, direct application)	1
			Venomous spider bites	Chewed (E, direct application)	2
			Snakebite *shanu*	Chewed (E, direct application), Soaked (E, friction), decoction (E, warm bath)	9
Centropogon cornutus (L.) Druce Hor 377 CAMPANULACEAE (sub)shrub	*isku xeta bata* *xudi batxia*	Leaves	Lymphatic disorder	Heated up (E, cataplasm), decoction (E, warm bath)	4
			Canker sores, cold sores	Patarashca* (E, direct application)	15
Clavija nutans (Vell.) B.Ståhl Hor 151 PRIMULACEAE shrub	*maspanewan*	Leaves	Black diarrhea	Decoction (E, warm bath)	9
			Influenza	Soaked (I, ingestion)	9
			Infected throat	Pounded (E, direct application)	1
Clavija weberbaueri Mez Hor 111 PRIMULACEAE shrub/tree	*maspanewan*	Leaves	Black diarrhea	Decoction (E, warm bath)	13
			Hernia	Soaked (E, friction)	2
			Testicle descended, fever	Soaked (E, friction)	6
			Infected throat	Soaked or heated up (I, ingestion)	13
			Boils	Pounded (E, direct application)	2

Clitoria amazonum Mart. ex Benth. Hor 433 FABACEAE shrub/tree	*nenautsi xankuma*	Leaves	Menstrual pain	Decoction (E, vaginal douche)	1
			Snakebite *shanu*	Squeezed (E, direct application), decoction (E, wash)	12
			Postpartum disorders	Decoction (E, warm bath)	2
			Permanent contraception	Decoction (E, warm bath,vaginal douche)	2
Clitoria pozuzoensis J. F.Macbr. Hor 432 FABACEAE shrub/climber	*nenautsi himiya* *tene kabia nenautsi*	Leaves Stem bark Roots	Joint and muscle pain	Decoction (I, ingestion), (E, warm bath)	10
			Long lasting contraception	Decoction (I, ingestion), (E, warm bath, (E, vaginal douche), squeezed (E, eye drops)	9
Connarus punctatus Planch. Hor 199 CONNARACEAE liana	*anu xaxe*	Leaves	Seizures, body tremor	Decoction (E, warm bath)	8
		Leaves and bark	Conjunctivitis	Soaked (E, wash, eye drops)	14
			Cracked skin of the foot	Patarashca* (E, squeeze in affected part)	1
Cordia nodosa Lam. Hor 446 BORAGINACEAE shrub/tree	*kapa yubu*	Leaves	Testicular inflammation	Soaked (E, direct application)	1
			Seizures, epilepsy	Squeezed (E, eye drops)	12
		Leaves and bark	Venomous bite – spider	Squeezed (E, direct application)	11

Cuspidaria floribunda (DC). A. H. Gentry Hor 177 BIGNONIACEAE liana/climber	*hima nuin*	Leaves	Herpes zoster, shingles Boils Allergic dermatosis	Patarashca* or soaked (E, squeeze in affected part) Patarashca* (E, direct application) Soaked (E, direct application)	15 3 2
Desmodium axillare (Sw.) DC. Hor 054 FABACEAE (sub)shrub	*xanu tamu nenautsi*	Leaves	Muscle stimulant	Decoction (E, warm bath, wash)	12
Dioscorea acanthogene Rusby Hor 243 DIOSCOREACEAE climber	*dantan ikan hina*	Leaves	Joint and body pain, rheumatism	Decoction (E, warm bath, wash)	10
Dolichandra uncata (Andrews) L.G. Lohmann Hor 213 BIGNONIACEAE liana/climber	*bunpa mentsisa*	Leaves	Pain in the ribs and body Dizziness, loss of consciousness	Decoction (E, warm bath) Squeezed (E, eye drops) Decoction (E, warm bath)	10 6
Drymonia coccinea (Aubl.) Wiehler Hor 064 GESNERIACEAE epiphyte/climber	*xuke txixin bata*	Leaves	Hemorrhoids Testicular inflammation	Soaked (E, direct application) Soaked (E, direct application), pounded (E, friction)	2 14

Drymonia tenuis (Benth.) J. L. Clark Hor 189 GESNERIACEAE epiphyte/climber	*nuin hene watima*	Leaves Leaf juice	Cutaneous infection Conjunctivitis Nightmares, tranquilliser Herpes zoster Stye Sight disorder	Patarashca* (E, direct application) Soaked (E, eye drops) Squeezed (E, eye drops) Patarashca* (E, direct application) Squeezed (E, eye drops) Squeezed (E, eye drops)	2 6 4 4 2 2
Eirmocephala brachiata (Benth. Oerst.) H. Rob. Hor 543 ASTERACEAE (sub)shrub	*kape txinkan*	Leaves	Muscle relaxant Lumbar spine pain	Decoction (E, warm bath) Heated up (E, cataplasm) Decoction (E, wash)	9 5 5
Erythrina ulei Harms. Hor 023 FABACEAE tree	*kaxu* *amasisa* (Spanish)	Leaves	Infections in general	Decoction (E, warm bath), Soaked (E, wash)	11
		Stem bark	Inflamed wound	Pounded (E, friction)	10
Fischeria stellata (Vell.) E. Fourn Hor 101 APOCYNACEAE climber	*yawa tsis nuin*	Leaves	Ear inflammation Open wounds Skin infection	Patarashca* (E, direct application) Patarashca* (E, direct application) Patarashca* (E, direct application)	2 10 11

Fridericia japurensis (DC.) L. G.Lohmann Hor 204 BIGNONIACEAE liana	*nuin himi taseya*	Leaves	Lymph glands disorders Lymphogranuloma Boils	Soaked (E, friction) Soaked (E, friction) Pounded (E, friction), soaked (E, squeeze in the afected part)	2 2 12
Goeppertia pavonii (Körn.) Borchs. & S.Suárez Hor 167 MARANTHACEAE herb	*mani pei taxipa xiwaya*	Leaves	Vomit, diarrhea Fainting emergency Fainting Nightmares, insomnia Convulsions, epilepsy Headache	Squeezed (E, eye drops) Squeezed (E, eye drops) Decoction (E, warm bath) Squeezed (E, eye drops) Decoction (E, warm bath) Squeezed (E, eye drops)	1 2 2 1 10 1
Guazuma crinita Mart. Hor 191 MALVACEAE tree	*patxa kaman kenan* *bolaina blanca* (Spanish)	Leaves	Behaviour disturbances Sting ray Scabies	Decoction (E, warm bath) Patarashca* (E, direct application) Patarashca* (E, direct application)	18 1 9
Herrania balaensis P. Preuss. Hor 225 MALVACEAE tree	*nesan paubin*	Leaves	Tranquilliser Stiff neck Lumbago	Decoction (E, warm bath) Heated up (E, cataplasm) Heated up (E, cataplasm)	1 2 2

Hymenopus arachnoideus (Fanshawe & Maguire) Sothers & Prance Hor 214 CHRYSOBALANACEAE tree	*nixu pei dani uma nia*	Leaves	Facial palsy Fainting, insanity	Soaked (E, friction) Decoction (E, warm bath)	1 10
Justicia dumetorum Morong. Hor 472 ACANTHACEAE (sub)shrub	*matsi dantunkuya*	Leaves	Chill without fever, hypothermia	Decoction (E, warm bath)	12
Lacistema aggregatum (P. J. Bergius) Rusby Hor 176 LACISTEMATACEAE shrub/tree	*xane tenan metxa*	Leaves	Protuberance in vagina Prolapse Boils Strong headache Labour induction Postpartum headache	Patarashca* (E, direct application) Pounded (E, direct application) Soaked (E, squeeze directly) Soaked (E, wash), decoction (E, wash), Patarashca* (E, squeeze in the afected part) Soaked (E, friction) Decoction (E, warm bath)	10 1 1 8 1 1

Lacmellea edulis H. Karst. Hor 181 APOCYNACEAE tree	*hane bata*	Leaves	General weakness	Pounded (E, friction)	2
			Vomiting, dizziness, nausea	Soaked (I, ingestion)	2
			Headache	Soaked or heated up (E friction)	3
			Headache, fainting	Decoction (E, warm bath)	6
Leonia glycycarpa Ruiz & Pav. Hor 391 VIOLACEAE tree	*tunku dau bata*	Leaves	Diarrhea due to infection	Decoction (I, ingestion)	1
		Stem bark	Struma	Decoction (E, friction)	2
			Boils	Soaked (E, direct application)	2
			Inner tumor	Decoction (I, ingestion)	2
			External tumor	Decoction, soaked (E, friction)	8
			Shoulder or hip pain	Decoction (E, friction)	1
			Snakebite *shanu, kamux*	Pounded (E, squeezed in wound)	14
Machaerium cuspidatum Kuhlm. & Hoehne Hor 122 FABACEAE liana	*kapa xeta nenautsi*	Leaves	Open wound, cut	Chewed, pounded, heated up (E, direct application)	20
			Body pain	Decoction (E, warm bath)	1
			Venomous bite *mai dunu*	Soaked (E, squeezed in wound)	1
			Skin affections	Patarashca* (E, squeeze in affected part), decoction (E, wash)	2
Manihot brachyloba Müll. Arg. Hor 493 EUPHORBIACEAE shrub/climber	*dua pei*	Leaves	Dizziness, fainting	Decoction (E, warm bath)	10
			Headache	Decoction (E, wash)	10

Mascagnia eggersiana (Nied.) W.R.Anderson Hor 172 MALPIGHIACEAE climber	*nixi bata pei txumi*	Leaves	Inflamed tooth, swelling	Decoction (E, plaster), pounded (E, squeezed in the mouth)	7
			Snakebite *shanu*	Pounded, soaked (E, squeezed in wound)	19
Mayna odorata Aubl. Hor 067 ACHARIACEAE shrub/tree	*date maxan* *maxanewan* *maxamawan*	Leaves	Testicular inflammation	Soaked, pounded (E, wash)	2
			Tinea capitis	Patarashca* (E, direct application)	1
			Epilepsy		1
			Headache	Decoction (E, cold bath)	9
			Skin afections	Decoction (E, warm bath)	9
			Postpartum disorders	Patarashca* (E, direct application) Soaked (I, ingestion)	2
Mendoncia pedunculata Leonard Hor 086 ACANTHACEAE liana	*bunpa pei xiwaya*	Leaves	Epilepsy, seizures	Decoction (E, warm bath)	10
			Body pain	Soaked (E, wash)	10
			Snakebite *shanu*	Chewed (E, squeeze in wound)	10
			Otitis	Patarashca* (E, direct application)	1
Myrcia densiflora (Poepp. ex O. Berg) A. R.Lourenço & E. Lucas Hor 093 MYRTACEAE shrub/tree	*mani yuxin*	Leaves	Dizzines, nightmares	Decoction (E, cold bath)	1
			Fainting	Pounded (I, squeeze the leaf juice in the mouth)	10

Myrcia lonchophylla A. R.Lourenço & E. Lucas Hor 136 MYRTACEAE shrub/tree	*kankan takanpi*	Leaves	Vomit, diarrhea, fainting	Soaked (I, ingestion), decoction (E, warm bath)	12
Matisia cordata Bonpl. Hor 422 MALVACEAE tree	*ixtxibin* *sapote* (Spanish)	Leaves	Labour induction Pregnancy care	Soaked (I, ingestion), pounded (E, friction, wash) Soaked (E, friction, wash)	14 10
Nautilocalyx pallidus (Sprague) Sprague Hor 280 GESNERIACEAE herb	*txatxa matsi* *awa himi xudu dau*	Leaves	Fever or flu prolonged Gallbladder inflammation Hypertermia Bone and joint pain Seizures, epilepsy Body paralysis	Decoction (E, warm bath), soaked (E, friction) Decoction (E, wash) Soaked (E, cold bath) Soaked (E, friction) Squeezed (E, eye drops) Soaked (E, cold bath)	4 2 1 2 2 1
Neea divaricata Poepp. & Endl. Hor 042 NYCTAGINACEAE shrub/tree	*kuxun himi* *txuxtiwan* *txuxti*	Leaves	Bleeding	Decoction (E, warm bath)	15

Neea spruceana Heimerl.	*txuxtiwan*	Leaves	Flatulence	Pounded (E, poultice)	10
Hor 096			Bleeding	Decoction (E, warm bath)	1
NYCTAGINACEAE			Snakebite *mai dunu*	Soaked, Patarashca (E, squeezed in the wound)	4
shrub/tree					
Oxalis leptopodes G. Don	*tete bexmi*	Leaves	Chronic diarrhea	Decoction (E, wash, friction)	10
Hor 232			Strong diarrhea, vomit	Decoction (I, ingestion)	6
OXALIDACEAE					
sub/shrub					
Passiflora araujoi Sacco	*nai tatxa*	Leaves	Restorative, vital tonic	Decoction (E, warm bath)	10
Hor 091			Fainting, dizzines	Decoction (E, cold bath)	1
PASSIFLORACEAE					
climber					
Paullinia tenera Poepp. & Endl.	*hasim punu nenautsi*	Leaves	Inflamation after	Decoction (E,warm bath)	2
Hor 016			snakebite Body pain after	Decoction (E, warm bath)	2
SAPINDACEAE			hard work	Decoction (E, warm bath)	10
climber			Twisted joint		
Pentagonia amazonica (Ducke) L. Andersson & Rova	*nanewan*	Leaves and bark	Epilepsy, seizures	Decoction (E, warm bath)	13
Hor 104		Fruits	Increases fertility	Unprocessed (I, ingestion)	1
RUBIACEAE		Leaves	Increases fertility	Decoction (E, cold bath)	1
tree			Dizzy, fainting, seems insane	Decoction (E, cold bath)	1

Philodendron ernestii Engl. Hor 218 ARACEAE epiphyte/climber	*xuni pei tatxunya*	Leaves Aerial parts	Nervous tic Lumbar spine pain Facial palsy	Heated up (E, cataplasm), pounded (E, direct application) Heated up (E, friction) Decoction (E, friction, wash, poultice)	16 4 4
Philodendron exile G. S. Bunting Hor 100 ARACEAE epiphyte/climber	*baxu taka nixi* *upi dau pei mesi*	Leaves	Vomit	Soaked (I, ingestion)	11
Philodendron fibrillosum Poepp. Hor 540 ARACEAE epiphyte/climber	*in tabi*	Leaves	Pregnancy protection Labour induction Boils	Soaked (I, ingestion), (E. friction) Soaked (I, ingestion), (E, friction) Soaked (E, wash)	3 4 10
Philodendron toshibae M. L. Soares & Mayo Hor 110 ARACEAE epiphyte/climber	*xawe batxi nuin* *xuni pei keneya*	Leaves	Female urinary infection Tumor	Decoction (E, wash) Leaf juice (E, friction)	10 1
Piparea multiflora C. F.Gaertn. Hor 184 SALICACEAE shrub/tree	*inu kexni*	Leaves	Gastrointestinal disorder Strong constipation, Disentery	Decoction (E, wash) Soaked (I, ingestion) Decoction (E, warm bath)	10 6

Piper casapiense (Miq.) C. DC. Hor 107 PIPERACEAE shrub	*awa denpan nixpu*	Leaves	Respiratory problems, swollen nose	Pounded (E, friction)	11
Piper costatum C. DC. Hor 088 PIPERACEAE shrub	*babu dau matsi*	Leaves	Dental follicle Inflamed tooth	Pounded (E, squeeze in the mouth) Grated (E, introduce in the teeth)	11 2
Piper leucophaeum Trel. Hor 139 PIPERACEAE shrub	*nixpu bayai*	Leaves	Snakebite *pexie xeta* Tooth protection *Nixpu pimaa* ceremony	Pounded (E, squeeze in the wound), decoction (E, warm bath) Unprocessed twigs (E, friction)	2 11
Pristimera tenuiflora (Mart. ex Peyr.) A. C. Sm. Hor 142 CELASTRACEAE liana	*nixi metunya*	Leaves	Any inflamation Snakebite *shanu pexie xeta*	Decoction (E,warm bath) Decoction (E, warm bath)	10 2
Prunus myrtifolia (L.) Urb. Hor 158 ROSACEAE tree	*biunx haxu*	Leaves	Genitourinary infection Persistent fever Snakebite *kana dunu*	Decoction (E, wash), patarashca * (E, direct application) Decoction (E, cold bath) Pounded (E, squeezed in the wound)	10 2 2

Pseuderanthemum lanceolatum (Ruiz & Pav.) Wassh. Hor 412 ACANTHACEAE herb	*mikin medan putani bata*	Leaves	Herpes, mycosis	Decoction (E, direct application)	2
			Estomatitis herpetica	Chewed (E, direct application)	1
			Always tears the eye	Soaked (E, wash)	2
			Epilepsy, seizures	Decoction (E, bath)	1
			Pimples in the mouth	Patarashca (E, squeeze in the mouth)	6
			Pregnancy protection	Soaked (E, friction)	2
			Labour induction	Soaked (E, friction), (I, ingestion)	5
			Snakebite	Grounded (E, squeeze in the wound)	2
Pulchranthus adenostachyus (Lindau) V. M Baum, Reveal & Nowicke Hor 005 ACANTHACEAE herb	*xuke bibex bata pei ewapabu*	Leaves	Venomous bite *xukedun*	Soaked (E, squeeze in the wound)	1
			Snakebite *kana dunu*	Grounded (E, squeeze in the wound)	1
			Snakebite *menpax*	Grounded (E, squeeze in the wound)	2
			Cold sores Eye disorders	Pataraskca* (E, squeezed in the mouth)	2
			Herpes	Chewed (E, direct application)	1
Quararibea wittii K. Schum. & Ulbr. Hor 431 MALVACEAE tree	*tui pei*	Leaves	Labour induction, cervical dilator	Soaked (I, ingestion), pounded (E, friction, wash)	12
			Pregnancy care	Soaked (E) friction, wash	5
			Newborn protection	Decoction (E, warm bath)	2

Rhynchospora umbraticola Poepp. & Kunth Hor 097 CYPERACEAE herb	*kamanen xatxi*	Leaves	Bowel infection Dog bite Rheumatism, artritis	Decoction (E, wash) Decoction (E, warm bath) Decoction (E, wash, friction)	10 2 11
Rosenbergiodendron longiflorum (Ruiz & Pav.) Fagerl. Hor 004 RUBIACEAE tree	*besti bata*	Leaves	Skin infection Snakebite	Patarashca* (E, direct application) Chewed or pounded (E, squeeze in the wound)	1 17
Rourea amazonica (Baker) Radlk. Hor 287 CONNARACEAE shrub/climber	*Nenautsi himiya tenekabia nenautsi*	Leaves	Menorrhagia Any inflamation Deep cuts Cancer Body pain Postpartum disorders Long lasting contraceptive	Decoction (E, warm bath) Decoction (I, ingestion) Decoction (I, ingestion), (E, squeeze in the wound) Decoction (I, ingestion) Decoction (E, warm bath) Decoction (E, wash) Decoction (I, ingestion)	4 2 3 2 2 1 2
Ruizodendron ovale (Ruiz & Pav.) R. E. Fr. Hor 061 ANNONACEAE tree	*kudu xai*	Leafy branches	Protection against epidemic	Burned (E, fumigant)	12

Schnella hirsutissima (Wunderlin)	*nixi pei dania*	Leaves	Malaise-fatigue, anxiety	Squeezed (E, eye drops)	5
Trethowan & R. Clark	*awa benen be pasa nixi*	Entire plant	Fainting	Decoction (E, warm bath)	5
Hor 246		ex situ	Haemorrhage	Decoction (E, warm bath)	2
FABACEAE			Blurred view	Heated up (E, local wash)	2
shrub/climber					
Siparuna cervicornis Perkins	*yuxin bia*	Leaves	Shock symptoms	Decoction (E, warm bath)	10
Hor 124			Insanity, fainting, anxiety	Decoction (E, cold bath)	1
SIPARUNACEAE					
shrub/tree					
Solanum anceps Ruiz & Pav.	*utsi bata pei taxipa*	Leaves	Ovarian inflammation	Decoction (E, vaginal douche)	4
Hor 319			Boils	Soaked (E, squeezed)	3
SOLANACEAE			Inflamed wound after the	Soaked (E, squeezed in the	1
shrub			snakebite	afected part)	
Solanum barbeyanum Huber	*i txiux*	Leaves	Mastitis	Soaked (E, friction, squeezed in	2
Hor 439			Boils	affected part)	
SOLANACEAE			Infected wound	Pounded (E, wash)	6
shrub/climber		Fruit	Boils prevention	Pounded, soaked (E, wash)	9
				Unprocessed (I, ingestion)	3
Solanum sessile Ruiz & Pav.	*xau bata*	Stem bark	Hyperhidrosis	Soaked (E, cold bath)	13
Hor 010		Leaves	Bone and joint pain	Decoction (E, warm bath)	3
SOLANACEAE			Snakebite *kamux*	Patarashca (E, squeezed in the	20
shrub				affected part), soaked (E,	
				friction), decoction (E, wam bath)	

Solanum thelopodium Sendtn.	*kamuxun bata*	Leaves	Snakebite *kamux*	Chewed or pounded (E, squeezed	15
Hor 303				in the wound), soaked (E, friction)	
SOLANACEAE					
shrub					
Strychnos tarapotensis Sprague &	*nutxun tun*	Leaves	Facial palsy	Pounded (E,wash), infusion (E,	6
Sandwith				wash)	
Hor 013			Convulsions, epilepsy	Decoction (E, warm bath)	7
LOGANIACEAE			„susto“	Infusion (E, wam bath)	1
climber					
Tanaecium dichotomum (Jacq.)	*inawan madi itsa*	Leaves	Fainting	Decoction (E, warm bath)	10
Kaehler & L. G. Lohmann			Epidemic protection	Burned (E, fumigant)	4
Hor 163			Newborn cries to faint	Decoction (E, warm bath)	4
BIGNONIACEAE			Convulsions, epilepsy	Decoction (E,warm bath)	4
liana			Disease protection	Decoction (E,warm bath)	5
Tradescantia zanonia (L.) Sw.	*bake bixtun*	Leaves	Epilepsy, seizures	Decoction (E, cold or warm bath),	5
Hor 317	*txaxu bake bixtun*			squeezed (E, eye drops)	
COMMELINACEAE	*cañagua* (Spanish)		Pregnancy care	Soaked (E, friction)	5
(sub)shrub			Labour induction	Soaked (I, ingestion), (E, friction)	20

Urceolina cyaneosperma (Meerow) Christenh. & Byng Hor 105 AMARYLLIDACEAE herb	*dunu huda* *anu maspu*	Entire plant ex situ	Pain in the legs Labour induction	Pounded (E, friction) Soaked (I, ingestion), pounded (E, friction)	1 16
Xylosma tessmanii Sleumer Hor 223 SALICACEAE shrub/tree	*inu kexni*	Leaves	Gastrointestinal infection Constipation, stomach pain, colic	Decoction (E, wash) Decoction (E, warm bath), soaked (I, ingestion)	10 6

*HK: *Huni Kuin*, S: Spanish; # E: externally, I: internally; ‡ FC: Frequency of citation

Appendix 3: Comparison of medicinal plants uses among different cultures

Table A3 Congruent uses of medicinal plants by different ethnic groups and IIAP database

Species	**IIAP** Database Peru	**Ese Eja** Madre de Dios Peru La Paz/Bolivia	**Kaxinawa** Jordão River State Acre Brazil	**Quechua** Chazuta Valley San Martin Peru	**Chayahuita** Paranapura Basin Loreto Peru	**This study** Curanja River Purus Peru
Campomanesia speciosa				Headache		Headache
Forsteronia graciloides				Aching joints		Any kind of inflammation
Leandra dichotoma				Wound antiseptic Vaginal candidiasis		Infections
Malachra alceifolia					Childbirth	Childbirth
Machaerium cuspidatum					Wound/cut	Wound/cut
Solanum barbeyanum					Inflammation	Inflammations
Lygodium venustum			Animal or human bite			Snakebite
Caamembeca spectabilis			Animal or human bite			Snakebite
Dianthera pectoralis	Bleeding Sedative					Postpartum bleeding Fainting
Mayna odorata		Skin fungal Skin eruptions				Mycosis of the scalp Dermatosis
Dracontium spruceanum	Snakebite	Snakebite		Snakebite	Snakebite	Snakebite
Begonia glabra	Digestive disorders					Stomach ache
Adenocalymma impressum	Diarrhoea					Diarrhoea
Dolichandra unguis-cati	Nervous disorders					Dizziness, confusion Severe fainting
Mansoa alliacea				Hunting		Hunting
Bixa orellana	Cicatrising Skin inflammations	Canker sores				Deep cut Canker sores Skin infections
Cordia nodosa	Convulsions		Animal or human bite			Epilepsy *Xina xuku* spider bite
Centropogon cornutus	Skin swellings					Swollen lymph nodes in the groin
Dichorisandra hexandra	Seizures Seizures due to "mal aire"					Epilepsy, convulsions, cramps
Euphorbia hirta					Wound/cut	Cuts
Senna hirsuta Fabaceae	Aches and pains					Body pain

Casearia sylvestris	Anti-inflammatory					Inflammation - tonsillitis
Hyptis capitata Lamiaceae	Mycosis					Irritated scalp
Banisteriopsis caapi	Hallucinogen	Hallucinogen in shamanistic divination and cure			Ayahuasca preparation	Ayahuasca preparation
Abuta grandifolia	Aphrodisiac	Male aphrodisiac		Aphrodisiac	Diarrhoea	Aphrodisiac Diarrhoea
Heisteria acuminata	Skin infections					Herpes
Petiveria alliacea	Epilepsy	"saladera" (bad luck)				Epilepsy "panema" (bad luck)
Piper aduncum	Diarrhoea				Stomach	Diarrhoea Vomiting
Piper callosum	Calming					Nightmares Dizziness
Piper marginatum			Pain, aches			Headache
Piper hispidum		Cuts				Infected wound
Piper peltatum	Stingray sting					Stingray sting
Calycophyllum spruceanum	Cicatrizing	Cuts		Wound antiseptic	Wound/cut	Burns, Injuries
Faramea multiflora	Fever					High fever
Hamelia axillaris	Bleeding					Bleeding
Psychotria viridis	Admixture for ayahuasca	Admixture for ayahuasca		Employed to divine future events through the visions induced by the plant decoction		Preparation of ayahuasca brew
Uncaria tomentosa	Stomach and intestinal ulcers Rheumatism	Kidney ache				Gastritis Peptic ulcers Kidney pain Rheumatism
Annona ambotay			Energy level			To encourage To cure laziness
Solanum mite	Snakebite				Inflammation	Inflammations Snakebite
Theobroma cacao		Birth aid				Birth aid
Clavija weberbaueri	Dysentery					Dysentery
Lantana cámara	Impetigo					Skin irritations and infections
Leonia glycycarpa	Abscess Tumor					Abscess Tumor *hi tunkua*

Appendix 4. Questionaire presented to plant specialists

N° de Grabación: .... **N° de Colección:** ....

FICHA ETNOBOTÁNICA

Foto N°: ....

1. NOMBRE científico...

Nombre(s) local(es) ....

Traducción..

2. ESPECIE.. **3. FAMILIA** ....

4. UBICACIÓN GEOGRÁFICA: Dpto:... Prov:...
Dist:... Lugar: ....

Coordenadas Geográficas: Latitud:................................... Longitud:...............................Altitud .... msnm.

5. ESTADO: Cultivado ( ) Silvestre ( ) Semi-silvestre ( ) Arvense ( )

6. ORIGEN: Nativa ( ) Introducida ( ) Naturalizada ( )

7. COSECHA o recolección: Mes (.....................................) Estación (.....................................)

8. SIEMBRA o rebrote: Mes (.....................................) Estación (......................................)

9. PROPAGACIÓN: Semilla ( ) Esqueje ( ) Estaca ( ) Bulbo ( ) Raíz ( )

10. FENOLOGÍA: Florecimiento ( ) mes Frutos ( ) mes Semilla ( ) mes

11. FUENTE de Colección: Campo de cultivo ( ) Campo disturbado ( ) Purma ( ) Huerto familiar ( )
Bosque primario o bosque real ( )

Se comercializa? Si ( ) No ( )

12. HÁBITO de crecimiento: Herbácea anual ( ) Herbácea bianual ( ) Herbácea perenne ( ) Arbustivo ( ) Arbóreo ( ) Perennifolio ( ) Caducifolio ( ) Erguida ( ) Decumbente ( ) Rastrera ( ) Trepadora ( ) Arrosetada ( )

13. USOS: Alimenticio ( ) Frutal ( ) Medicinal ( ) Forestal ( ) Industrial ( ) Tintórea ( ) Textil ( ) Artesanal ( ) Ornamental ( ) Forrajera ( ) Mágico-religiosa ( ) Construcción ( ) Leña ( ) Cerco vivo ( ) Caza - instrumento ( ) veneno ( ) Pesca - instrumento ( ) veneno ( )

Si es medicinal: **Para que ENFERMEDAD** (Síntomas)...

....

....

....

Ritual ( ) Desarrollar:...

14. COMBINACIÓN con otras plantas ....

15. PARTE USADA Raíz ( ) Tallo ( ) Rizoma / bulbo ( ) Hojas ( ) Flores ( ) Fruto ( ) Semilla ( ) Corteza ( ) Brotes ( ) Toda planta ( ) Resina ( ) Fibra ( ) Pigmento ( ) Látex ( )

16. Edad de USO: Tierna ( ) Jóven ( ) Adulta ( ) 17. **Aplicación**: Externa ( ) Interna ( )

17. Forma de USO: Fresco ( ) Seco ( )

18. Modo de PREPARACIÓN: Crudo ( ) Chapeado ( ) Cocimiento ( ) Infusion ( ) Patarashka ( ) Macerado ( ) Masticado ( ) Procesado ( ) otros ( )*

Ud. de medida Planta ………………………………………………… / Ud. de medida Agua…………………………………………………………

19. TIEMPO de preparación: ……

20. DOSIS empírico: ……………………………………………………......

21. Modo de APLICACIÓN:

Ingestión ( ) Baño frío ( ) Baño tibio ( ) Frotación ( ) Emplasto ( ) Cataplasma ( ) otros ( )**

22. Respectiva DIETA

23. FRECUENCIA de uso: …………………………………………………… 23. **TIEMPO de uso**: ………………………………………………

24. INDICACIÓNES antes de alimentos ( ) ………………………….. después de alimentos ( ) …………………………………….

Otras indicaciones ( ) ……

25. FUENTE de información: ……

26. COLECTOR / N° de Colección: ………

27. LUGAR ……………………………………………………………………………… Fecha: ……………………………………………………………

)*)**

31. OBSERVACIONES:

Fuente: Basado en García, M. 1996 y Álban, J. 1985.

Appendix 5. Household questionnaire presented to community members

Entrevista semi-estructurada en domicilio (household)

1) Comunidad nativa:...

2) Nombre del respondente: ....

3) Su edad:..

4) Su profesión:..

5) Lugar donde nació:...

6) Número de años pasados en la comunidad:...

7) ¿Quién cree que es la persona más informada sobre el uso de plantas medicinales en la familia?..

8) ¿Quién cree que es la persona más informada sobre el uso de plantas medicinales en la comunidad?...

9) A quién se dirigía en caso de enfermedad?

- auto-medicación
- especialista vegetalista o naturista de la comunidad
- médico de la posta en Puerto Esperanza
- otros

10) Enfermedades ocurridas en la casa:..

11) Información sobre sus causas:..

12) Información sobre sus síntomas:...

13) Su respectiva cura:..

14) Cualquier remedio vegetal presente en la casa

1...

2. ....

3...

4...

14) Su uso y aplicación descrita por el informante

1...

2. ....

3...

4...

15) Plantas de uso medicinal cultivadas en la huerta..

16) Plantas silvestres de uso medicinal cerca de la casa..

Appendix 6. Photos from field work


Purus River


Purus Province's unbroken forest cover


Lower Curanja River in the dry season


The rainy season on the upper Curanja River


Transport of work material


River Curanja close to the village of Colombiana.


A typical household in the Cashinahua community


Colombiana village - a base for field work


Presenting the project aims to the Santa Rey Community


Community Assembly in Santa Rey


Community Assembly in Colombiana


Unpressed plant material gathered from forest walks


Conducting an interview with herbalists (Santa Rey)


Typical household in Santa Rey community


Key respondents of Colombiana, Adolfo y Marcelino


Medicinal herbs ready for cooking remedia

A view of the vegetation in the study area

Botanical sample collection during field walk

Botanical sample of Urceolina cyaneosperma (*awa huda*)

En route to a more distant collection site

Herbalists reviewing photos of last year's collections

Workplace in the community of Curanjillo

Informal interviews with plant specialists

Gathering botanical samples with herbalist and assistant


Recording of translations of *Hantxa Kuin* folk names


The only power source for charging equipment


Government school in Cashinahua village


Buttres roots of a giant *Ceiba pendantra* tree


Recording of Nixpu Pimaa ritual songs (Nueva Vida)


Presentation of the project results in Nueva Vida


Providing printed copies of the resulting information to


Workshop with key informants at the UNIA herbarium

Appendix 7: Photos from Herbarium

Botanical specimens ready for processing

Treatment of botanical specimens in the UNIA Herbarium

Assistants from UNIA students helped to process the collection of botanical specimens.

Appendix 8: The Field Guide of the neglected plants submitted to Field Museum in 2022

Provincia de Purús, Departamento de Ucayali, PERÚ

Plantas medicinales y rituales utilizadas por *Huni kuin*

1

Jana Horáčková[1,2], Maria Elena Chuspe Zans[3], Zoyla Mirella Clavo Peralta[4], Ludvík Bortl[2,5,6]

[1]Universidad Nacional Intercultural de la Amazonía, Pucallpa, Perú, [2]Department of Crop Sciences and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Prague, Czech Republic, [3] Departamento Académico de Ingeniería Civil y Ciencias Básicas, Universidad Nacional Intercultural de Quillabamba, Cuzco, Perú, [4] Herbario Regional de Ucayali, Instituto Veterinario de Investigaciones Tropicales y de Altura, Universidad Nacional Mayor de San Marcos, Pucallpa, Perú [5]Prague Botanical Garden, Prague, Czech Republic, [6]Students for the Living Amazon o.p.s., Prague, Czech Republic.

Photos by Jana Horáčková (horajana@gmail.com). Support by Universidad Nacional Intercultural de la Amazonía (UNIA) and Students for the Living Amazon [living-amazonia.org].
 This guide is part of the doctoral thesis of JH.
[fieldguides.fieldmuseum.org] **[xxxx]** versión 0.93 09/2022

1 ***Aphelandra acrensis***
ACANTHACEAE

2 ***Aphelandra acrensis***
yame bebe

3 ***Aphelandra caput-medusae***
ACANTHACEAE

4 ***Aphelandra caput-medusae***
basikun beshiwa

5 ***Encephalosphaera lasiandra***
ACANTHACEAE

6 ***Encephalosphaera lasiandra***
yawan kuxi dau

7 ***Justicia dumetorum***
ACANTHACEAE

8 ***Justicia dumetorum***
matsi dantunkuya

9 ***Mendoncia pedunculata***
ACANTHACEAE

10 ***Mendoncia pedunculata***
bunpa pei shiwaya

11 ***Pseuderanthemum congestum***
ACANTHACEAE

12 ***Pseuderanthemum congestum***
xuke bibex bata pei chudi

13 ***Pseuderanthemum lanceolatum***
ACANTHACEAE

14 ***Pseuderanthemum lanceolatum***
mikin medan putani bata

15 ***Pulchranthus adenostachyus***
ACANTHACEAE

16 ***Pulchranthus adenostachyus***
xuke bibex bata pei evapabu

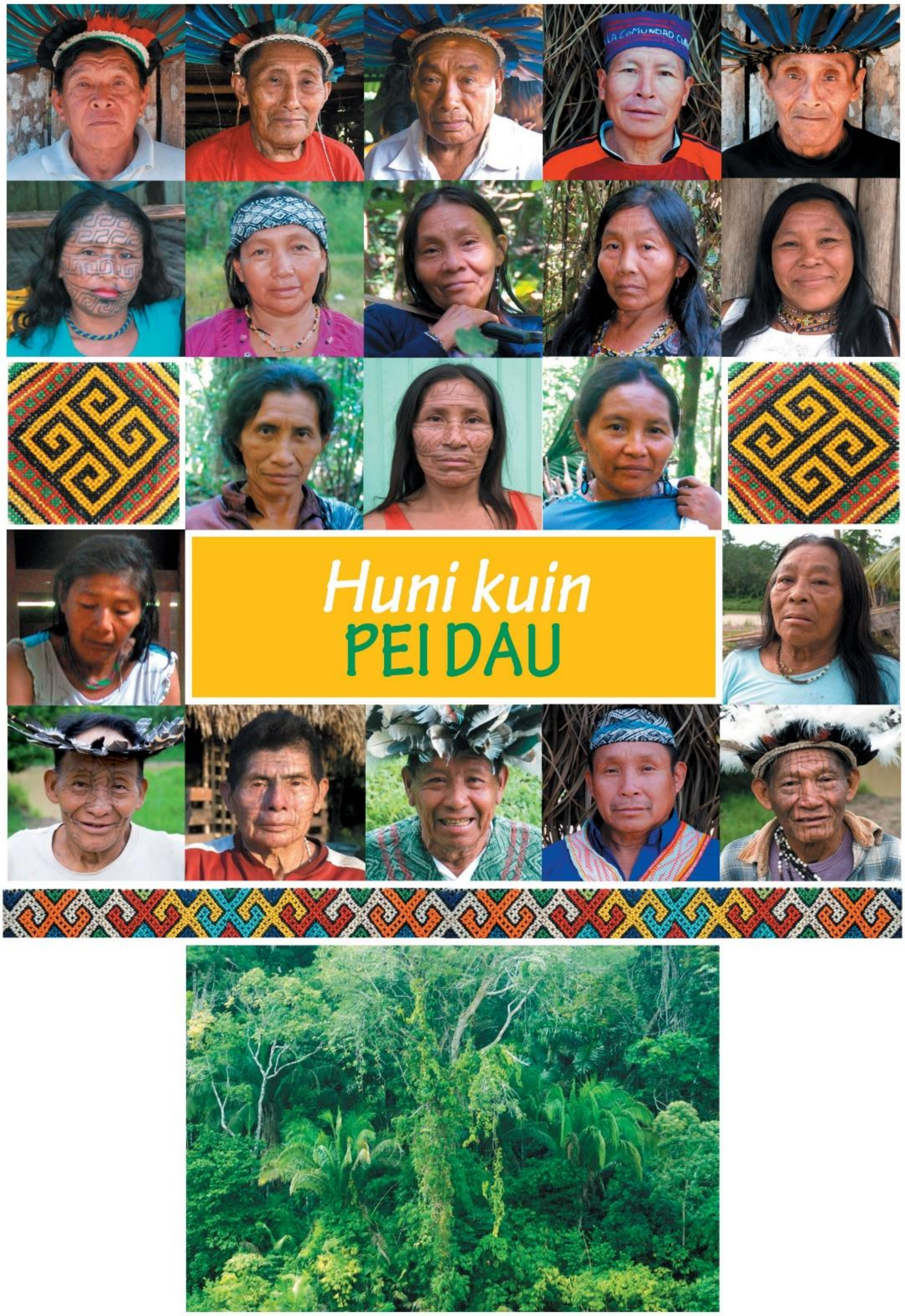
17 ***Mayna odorata***
ACHARIACEAE

18 ***Mayna odorata***
date mashan

19 ***Bomarea edulis***
ALSTROEMERIACEAE

20 ***Bomarea edulis***
dei yuxibun bixtu bexea

Appendix 9. Cover page of hard copy of transcriptions of recordings in *Hantxa Kuin* language



Appendix 10. Example page of hard copy of transcriptions of recordings in *Hantxa Kuin*

5-003 **Hor 244** *xau bata* MPC, ATS

Xau batadan xau isindiki isinteci xau isin dasabi isianya haven damuxtiki haven pei inun haven bichi bexatanan unpax matsipa inun yuatan haven naximatiki hayabi ketaxkinan matsi peitadunuaki hadabeven damustiki yuda isin xau dasibi isianyanan nukun xau isindauki haven pei ichapa atan damustiki.

5-004 **Hor 245** *tapu ininti* ATS, MPC

Tapu initidan bakeixta biabu e e ikai haven dauntiki nai tachamen, yuxin debumen, kanun kave tsabemen hanua betsa dau ichapa bixun min haven naximaii yuxin chakabun uinyanan bakeixtadan kaxa haidamiski min ma dauva main miski hanua yuxinin hadibivadi havendi bechextiki haven peivenan haven bichi chaka chaka atan yuatan naximatiki hayabi ketaxkinan hai tachayabi atiki haven bechexti betsadan xanenatuki betsadan tudu padada ja dabeki javen bechextidan min ma dauva mainmiski yuxinin betsavadan haskamiski.

Tapu inintidan yuxinin hadibivadauki hati bitiki tapu ininti bibain, yuxin bia bibain, chana chixin yame chana bibain, yuxin mentsis bibain, yuxinin mani bibain, yuxinin besteti bibain yuxinin paka butiki jativen naximatiki yuatanan haven bechexkina hatibitiki inkan nai bai bixunh, xane natu bixun maka huni bixun, yuxin bedu bixun, kuden ikanatu bixun isa hanakan datedan haven pei nananke bixun, kanun kave tsabe bitan hativen bechextiki yuxinin betsavadan.

5-005 **Hor 246** *nixpu pei dania* ATS

Nixpu pei daniadan yuxinendi hadibiva hu ikai haven atiki. Nixpu betsamen, bai dentumen, xinu inimen yuxinin pakamen. Yuxin bexmimen hanua betsa kanun kave tsabemen hati bixun atiki hu ikaidan unaismapaidan haven xani meshaidan haskaya hati bixun bechextiki. Haven naximatidan nishu betsa bixun, xane natu bixun yuxinin besteti bixun chana chixin yamechana hativen naximakin habiabuvendi min bechexaii hu iki haven xani meshayadan min haskava mainkiki bextecidan ana haskamaki maintan ea yuxinin hadibiva en ikaii. Ikaya peki ana habiatinvendi min akaii benavakinan ana bechexdiakinan haskavakin min xuxavaii mainvankinan ana yixin hayamaki naximakin bechexkinan min ma xuxava peki kanun kave tsabe, bai dentu, bata xukuya Pei nataxi, yuxinin paka amen chidani nishu, yuxin kexkamatsi, nishu pei dania hativen min naximaii. Bata xukuya pei nataxivenan haven xukuven min bedu natuis akaii bechexkinan.

5-006 **Hor 246** *nixpu pei dania* MPC

Appendix 11. Table A3 Demographic data of respondents and number of UR registered

Initials	Code	Name of respondent	Community	Gender	Age in 2015	UR
MPC	R1	Marcelino Pinedo Cecilio	Colombiana	M	76	535
ATS	R2	Adolfo Torres Silva	Colombiana	M	74	530
ARM	R3	Abilio Roque María	Santa Rey	M	68	261
ANP	R4	Adolfo Nacimiento Pérez †	Santa Rey	M	75	250
PT	R5	Pedro Tachiana Hermis	Santa Rey	M	73	325
WPF	R6	Waldemar Perez Ferreira †	Triunfo	M	64	135
JPP	R7	Josefa Puricho Perez	Triunfo	F	62	137
JTN	R8	Jose Torres Nacimiento	Curanjillo	M	57	155
JAT	R9	Jorge Aladino Torres	Curanjillo	M	56	164
FTM	R10	Filomeno Torres Márquez	Nueva Vida	M	77	196
LNH	R11	Laura Nacimiento Hermis	Nueva Vida	F	74	74
HTA	R12	Hérman Torres Alicio	Nueva Vida	M	74	110
ASM	R13	Alcira Samuel Maria	Santa Rey	F	65	42
CPM	R14	Concepción Pablo Melendez	Santa Rey	F	64	40
JNA	R15	Julia Nacimiento Aladino	Curanjillo	F	68	33
NPO	R16	Nora Prado Oliveira	Curanjillo	F	61	17
LRT	R17	Linda Roque Tachiana	Balta*	F	58	57
MTD	R18	Margarita Tachiana Dominguez	Colombiana	F	69	50
JTNa	R19	Josefa Torres Nacimiento	Nueva Vida	F	49	59
JTP	R20	Julia Torres Pérez	Nueva Vida	F	36	53

Appendix 12. Curriculum Vitae

Name: Mgr.A. Jana Horackova

Nationality: Czech Republic

Date of born: 4 February 1962

Address: Jenečská 172/25, 161 00 Praha 6

Phone: +420603293898

Email: horajana@gmail.com

EDUCATION:

PhD in Tropical Agrobiology and Bioresource Management - Czech University of Life Sciences Prague (2016 – 2024 anticipated).

Mgr.A. in Type design and Typography - Academy of Arts Architecture and Design in Prague (1989 - 1995). (*At the time of the study, the Bachelor's and Master's programmes were not distinguished at the Art Academies in Bohemia*.)

WORK EXPERIENCE:

National Intercultural University of the Amazon – Research fellow at project

- Study of the medicinal plants used in the Bena Jema community in defence of their health, in front of the COVID-19" (2020 – 2021 Yarinacocha, Peru).

National Intercultural University of the Amazon – Research fellow at project

- Response to organic fertilization of Cinchona officinalis (cinchona tree) at the National Intercultural University of the Amazon – Ucayali (2020 – 2021 Yarinacocha, Peru).

National Intercultural University of the Amazon – Research fellow at project

- Processing of freeze-dried extracts of the biological material of the botanical garden plants for the analysis of bioactive compounds (2020 - 2021; Yarinacocha, Peru).

National Intercultural University of the Amazon – Consultant for the Indigenous Partnership

- Member of the Commission for monitoring and implementation of the Professional School of the Career Natural Pharmacological Sciences (2020; Yarinacocha, Peru - to date home-based)

National Intercultural University of the Amazon – Consultant for the Indigenous Partnership

• Project Improvement and implementation of the House of Arts of the Native Peoples of the Amazon and Workshops of the traditional Amazonian art (2020 – 2021; Yarinacocha, Peru).

Herbarium of National Intercultural University of the Amazon – Research fellow at Research Unit of Herbarium

Executive director (July 6/7/2020 – 15/12/2021; Yarinacocha, Peru)

Agroforestry Nursery of National Intercultural University of the Amazon - Intern at Academic Department of Basic Sciences

• Supervision of reforestation projects (July 6/7/2020 – 15/12/2021; Yarinacocha, Peru)

National Intercultural University of the Amazon - Intern at Department of Pedagogy and Humanities

• Teaching in courses: Art and Creativity Workshop of the Amazonian Peoples, Music and Dance Workshop and Audiovisual Arts (2020 - 2021; Yarinacocha, Peru).

National Intercultural University of the Amazon – Research fellow at project

• Conservation of the Indigenous flora of the Peruvian Amazon: NURery and thematic garden of medicinal plants in the University Campus of the UNIA (2018 – 2019; Yarinacocha, Peru).

National Intercultural University of the Amazon – Organization of Workshop with Cashinahua healers

• Workshop: Exchange of experiences in the Cashinahua (Huni Kuin) traditional use of medicinal plants (7/12/2016 – 14/12/2016; Yarinacocha, Peru)

PLAMTAP - Consultant for Ethnobotany and the Indigenous Partnership

• Vice-president of the Association for the Research, Conservation and Management of Medicinal Plants of the Peruvian Amazon – PLAMTAP (2018 –2021; Pucallpa, Peru; to date home-based)

Cashibococha Botanical Garden - Research fellow and executive director

• President of the Association Cashibococha Botanical Garden (2018 –2021; Cashibococha, Peru; to date home-based)

National Intercultural University of the Amazon - Intern at Academic Department of Environmental Sciences

- Teaching course on Medicinal Ethnobotany and Medicinal Plants Technology, teaching assistant for Botany and Dendrology courses (2018 - 2019; Yarinacocha, Peru)

Project Principal Investigator

- Conserving the Indigenous flora of the Peruvian Amazon, Nursery and Thematic Garden of Medicinal Plants on the University Campus of the UNIA (2018 - 2019; Yarinacocha, Peru)

Project Principal Investigator

- Medicinal Plants Component in the research project "Recovery, management and conservation of ecological scenarios and their components on the campus of the UNIA for the creation of a Regional Botanical Garden (2017-2018; Yarinacocha, Peru)

National Intercultural University of the Amazon – Consultant and organization of CoURe

- Organization of course: Libraries as a Fundamental Basis for Intellectual Development and Learning Methods (January 2017; Yarinacocha, Peru)

Ethnographical Museum of National Intercultural University of the Amazon – Executive director

- In charge of the House of Arts of the Amazonian peoples (2016 – 2021; Yarinacocha, Peru)

Project Principal Investigator - funded by National Intercultural University of Amazon

- Ethnobotanical and phytochemical study of plants used in folk and ritual medicine in the province of Purus (2010 - 2017; Purus, Peru).
- Survey of ethnobotanical inventory of medicinal plants (April – May 2015; Purus, Peru)
- Survey of ethnobotanical inventory of medicinal plants (June – August 2013; Purus, Peru)
- Survey of ethnobotanical inventory of medicinal plants (November / December 2012; Purus, Peru)
- Survey of ethnobotanical inventory of medicinal plants (November / December 2010; Purus, Peru)

Appendix 13. List of publications, manuscripts and conference contributions based on the doctoral study

Horackova J, Chuspe Zans ME, Kokoska L, Sulaiman N, Clavo Peralta ZM, Bortl L, Polesny Z. 2023. Ethnobotanical Inventory of Medicinal Plants Used by Cashinahua (*Huni Kuin*) Herbalists in Purus Province, Peruvian Amazon. Journal of Ethnobiology and Ethnomedicine. https://doi.org/10.1186/s13002-023-00586-4

Lipensky J, Bortl L, **Horackova J**, Chuspe Zans ME, Jauregui X, Clavo Peralta MZ, Pardo de Santayana M, Mixa M, Lojka B. 2017. Herbal Markets of the Pucallpa city, Peruvian Amazon. 58th Annual Meeting of the Society for Economic Botany. Conference poster.

Horackova J, Chuspe Zans ME, Clavo Peralta Z M, Ludvík Bortl. Field guide: Plantas medicinales utilizadas por Cashinahua, Purús, Ucayali, PERÚ. Field Museum of Natural History, fieldguides. fieldmuseum.org. 2023 (Manuscript under review Field Museum of Natural History LB)

Garcia-Ruíz J, Asencios-Tarazona V, Lozano-Reategui RM, Ruíz-Yance IO, Pérez- Hidalgo LT, Ramírez-Castro M, **Horackova J**, Clavo- Peralta ZM, Huamán de la Cruz AR. Medicinal-ancestral use of plants in the symptomatic treatment of COVID-19 in the native urban-rural Shipibo-Konibo "Bena Jema" community of Ucayali-Peru. (Manuscript under review of Ethnobotany Research and Applications).

Oisel G, **Horackova J**, del Águila Valerio N, Camargo E. Nomenclatura etnobotánica de la lengua *Hantxa Kuin* o Cashinahua (grupo Pano): Estrategias de lexicalización y usos medicinales de las plantas selváticas del Purús, Perú. (Manuscript in preparation).

BOOK CHAPTERS:

Horackova J. 2020. Kene y tres plantas que atraviesan todas las culturas amazónicas. Amazonia unida 2da parte. Mendel University, Brno.

Horackova J. 2014. *Pei dau*, leaf medicine of Peruvian Cashinahua: Ethnobotanical inventory of Peruvian plants used in popular medicine and ritual in the Province of Purus. Przyroda i kultura Peru. Wydawnictwo Uniwersytetu Jagiellonskiego.