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Review Article

Compendium of Native Medicinal Plants of Peru at Risk of Extinction: A Comparative Analysis of the IUCN Red List and Supreme Decree 043-2006-AG

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ABSTRACT

The use of medicinal plants in Peru dates back to pre-Inca times and continues today. However, various species have restricted distribution, reduced populations, and anthropogenic pressures that categorize them as threatened to some degree, according to the International Union for Conservation of Nature (IUCN) and Supreme Decree No. 043-2006-AG (Peruvian law). The aims of this study were to identify threatened native medicinal species, their endemism, biological status, and presence in local markets. We conducted a comprehensive review of peer-reviewed and gray literature on medicinal plants and their conservation. Searches were conducted in Web of Science, Google Scholar, PubMed, and ScienceDirect. We also examined the species listed in Supreme Decree No. 043-2006-AG to identify those with medicinal uses documented in ethnobotanical or ethnopharmacological sources. We identified 96 species of medicinal plants native to Peru that are classified as threatened according to the IUCN and Supreme Decree No. 043-2006-AG, grouped into 43 botanical families. Of the total, 90 are found in the wild and 33 are endemic. In addition, 36 species are sold in local markets. Our study highlights the need to strengthen the incorporation of these species into research programmes, considering their natural distribution, use, and anthropogenic pressures in the design of strategies aimed at their conservation and sustainable management.

Keywords: IUCN Red List; biodiversity loss; threatened species; ethnobotany; traditional knowledge; sustainable use.

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INTRODUCTION

Medicinal plants represent one of the most important natural inputs for the pharmaceutical industry, a sector that today faces growing demand and depends heavily on these resources (Davis & Choisy, 2024). In many developing countries, nearly 80% of the population uses herbal remedies as part of their primary health care, while in developed countries more than 25% of prescription drugs come from wild medicinal plant species (Hamilton, 2004). In this context, and given the growing interest in natural products and secondary metabolites, the use of medicinal plants continues to expand globally (Nalawade & Tsay, 2004). However, according to the International Union for Conservation of Nature (IUCN) and the World Wildlife Fund (WWF), there are between 50,000 and 80,000 species of flowering plants used for medicinal purposes, of which an estimated 15,000 species are threatened due to habitat destruction (Chen et al., 2016). The IUCN Red List provides a framework for assessing the conservation status of biodiversity on a global scale and guiding planning and management policies. By integrating information on geographic distribution, population size and trends, ecological characteristics, threats, and conservation measures, it provides a technical basis for evidence-based decision-making that is comparable across contexts. This system classifies species into nine categories: Not Evaluated, Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild, and Extinct (IUCN, 2025).

In 2006, the Peruvian government enacted Supreme Decree No. 043-2006-AG, establishing the official classification of threatened wild plant species throughout the country. Developed through an open and participatory process based on IUCN criteria and categories, the list comprises 777 species, including 332 Orchidaceae and 41 Cactaceae. This regulatory framework is in line with Peru's commitments under the Convention on Biological Diversity, which emphasizes the conservation of biological diversity, the sustainable use of biological resources, and the equitable sharing of benefits derived from genetic resources. The decree provides a scientific and regulatory basis for conservation planning and management at the national level (Ministerio de Agricultura, 2006). In this same context, the Red Book of Endemic Plants of Peru is a joint effort between researchers and institutions that between 2003 and 2005, systematized information mainly from herbarium collections in order to identify and assess the degree of threat to taxa restricted to the national territory under the IUCN categories. Forty-three specialists participated in this process, documenting 5,509 endemic taxa, equivalent to 27.9% of Peru's flora, and creating a reference base for the development of monitoring and protection strategies aimed at conserving the country's endemic flora (León et al., 2006).

The long tradition of using medicinal plants in Peru dates back to well before the Inca Empire (1400 AD), and this knowledge has been passed down from generation to generation to present day (Devoto, 2016; Silva et al., 2025). In the northern Andes, early cultures such as the “Cupisnique” (first millennium BC) developed botanical traditions, laying the foundations for later healing systems (Bussmann & Sharon, 2009). These societies practiced forms of shamanism in which plants with psychoactive or therapeutic properties, including *Brugmansia* and *Cinchona* species, played an important role (Jordán, 2015). It is noteworthy that several *Brugmansia* species historically used in ceremonial contexts, including *B. arborea* (L.) Sweet, *B. sanguinea* (Ruiz & Pav.) D.Don, and *B. suaveolens* (Humb. & Bonpl. ex Willd.) Sweet, are now considered extinct in the wild, while multiple *Cinchona* species face varying levels of threat according to the IUCN Red List (IUCN, 2025). Global demand for quinine radically intensified this pressure: between 1752 and 1796, more than 8.5 million kilograms of

"cinchona" bark were exported, a trade that required the felling of some 11 million trees (Ruíz, 1792; Díaz et al., 2016). Peru is home to extraordinary environmental diversity: 78 of the 107 recognized ecoregions in the world and 28 of the 30 known climate types are found within its borders (Brako & Zarucchi, 1993). This complexity supports a high concentration of endemic species, many of which are restricted to only a few Peruvian departments (León et al., 2006). Some of these endemic species are traditionally used as medicinal resources, a practice that increases their vulnerability, as their limited distribution, small population size, and biological attributes already restrict their natural resilience. In several cases, harvesting involves the removal of entire plants from the wild, preventing their regeneration, while the expansion of anthropogenic pressures further degrades the ecosystems in which they grow (Castañeda et al., 2021; Seminario et al., 2024; Silva, 2023). In this regard, our study had the following objectives: (i) To identify native Peruvian medicinal plant species classified as threatened according to the IUCN Red List and Supreme Decree No. 043-2006-AG. (ii) To determine the endemism of these threatened species, their biological status, and their presence in local markets.

METHODOLOGY

Literature review

We conducted a systematic literature search in the Web of Science, Scopus, Google Scholar, PubMed, and ScienceDirect databases, following the review procedures described by Moher et al. (2009). The search strategy combined general terms related to medicinal plants, such as "herbal medicine," "medicinal plant," and "aromatic plant," with keywords associated to conservation, such as "sustainable use," "in situ conservation," "ex situ conservation" and "Peru." The review process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Agrawal et al., 2024) and is summarized in Figure 1. Our search covered studies published between January 1950 and June 2025 and included articles written in English or Spanish. The initial search yielded 748 records, encompassing research articles, reviews, commentaries, and letters. After screening each of the articles, nine studies were selected for full-text review and detailed assessment. We included records that mention or analyze medicinal species native of Peru classified by the IUCN from the Near Threatened (NT) category up to the categories with the highest threat levels and that they appear on at least one of the two lists of the IUCN Red List or in Supreme Decree No. 043-2006-AG. For each record, we compiled the threat category, scientific name, and traded.

In addition, we reviewed all species included in Supreme Decree No. 043-2006-AG, a Peruvian regulation that presents the official classification of endangered wild plants in the country (Ministerio de Agricultura, 2006). From the 777 species listed in the decree, we sought to identify those for which there are reports of use in traditional medicine, ethnobotany, or ethnopharmacology. To do this, we consulted various academic databases for the scientific name of each species in order to verify the existence of documented medicinal uses. When this information was confirmed, we selected a representative reference to support that use. Likewise, for each species, its threat category in the IUCN Red List was consulted in order to compare this global classification with that established by Peruvian regulations. We acknowledge that the procedure applied to the list in Supreme Decree No. 043-2006-AG does not strictly correspond to a systematic review in the classical methodological sense. Rather, it is a complementary analysis whose purpose was to broaden the scope of the study. To verify the origin and taxonomic classification of the species, we used specialized databases such as

Plants of the World Online (https://powo.science.kew.org/) and Tropicos (https://www.tropicos.org/home).

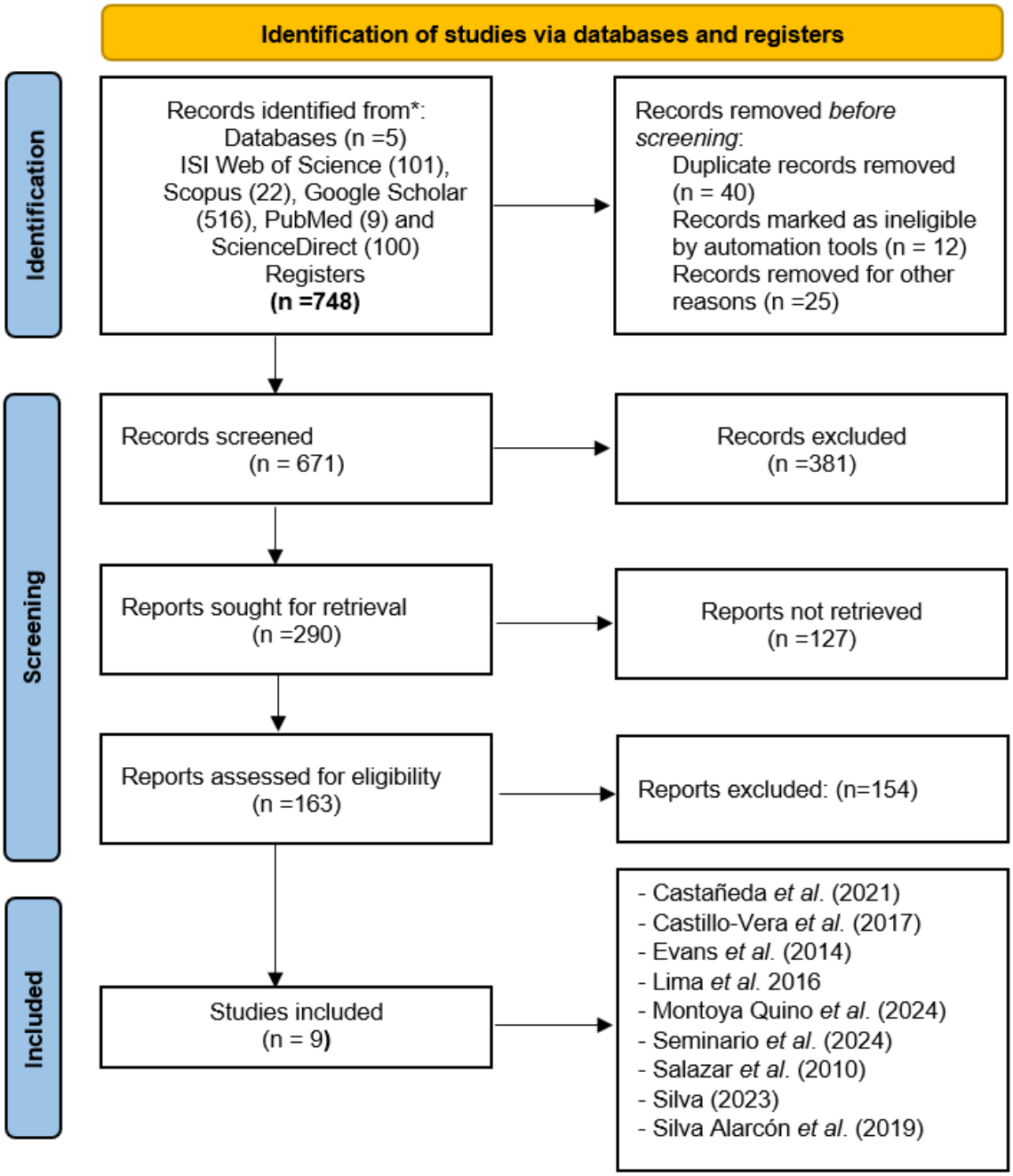


Figure 1: PRISMA flow diagram representing the procedure followed in this study.

RESULTS

Conservation status

We identified 96 species of medicinal plants native to Peru that face some degree of threat to their conservation (Table 1). Of these, 43 species were recorded through a systematic literature review, while the remaining 53 were identified by examining the species listed in Supreme Decree No. 043-2006-AG and verifying their medicinal use (Table 1). According to the highest categories on the IUCN Red List, the assessed species include seven classifieds as Vulnerable (VU), eleven Endangered (EN), two Critically Endangered (CR), and three Extinct in the Wild (EW). In contrast, the national categorization established by Supreme Decree No. 043-2006-AG recognizes 29 species as Vulnerable (VU), nine as Endangered (EN), and 25 as Critically Endangered (CR) (Fig. 2). These differences demonstrate that the two assessment systems are not directly equivalent, as they are based on different scales, criteria, and objectives. While the IUCN Red List is based on standardized criteria of global scope and includes only species that have been assessed internationally, Peruvian regulations incorporate a higher proportion of nationally threatened species, reflecting in greater detail the conservation priorities and specific conditions faced by medicinal plants within Peruvian territory.

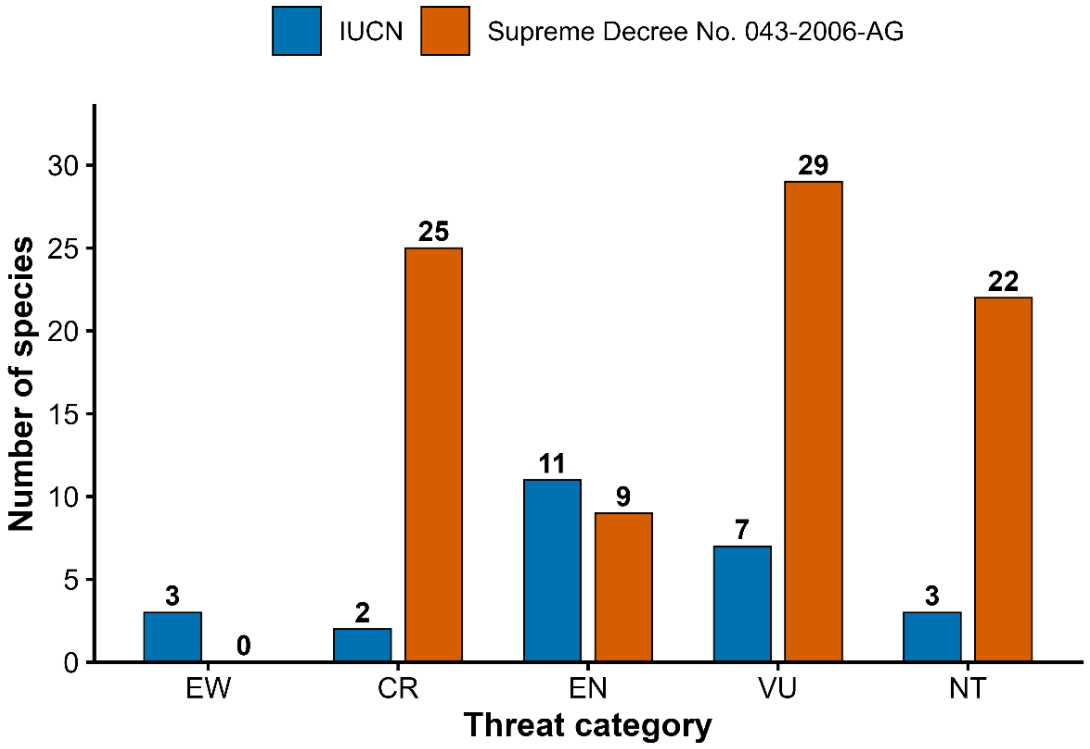


Figure 2: Number of species according to their category of threat base on to the IUCN Classification at global level; Classification at national level by Supreme Decree N. º 043-2006-AG.

Of the 96 endangered medicinal species recorded, 33 are endemic to Peru. These endemic taxa are unevenly distributed throughout the country, with Cajamarca being the region with the highest number of departmental records (thirteen species), followed by La Libertad with twelve species, Ancash with eight, Huánuco with seven, and Amazonas with six species (Fig. 3). Some departments have fewer or more endemic medicinal species; in part, these differences may be due to the geographic scope of the studies included in this review, as well as the assessments

of species listed in Decree No. 043-2006-AG. In Peru, there are 5,509 endemic plant species reported in the Red Book of Endemic Plants of Peru (León et al., 2006). Future research should determine which of these endemic taxa have medicinal uses and whether they face threats to their conservation.

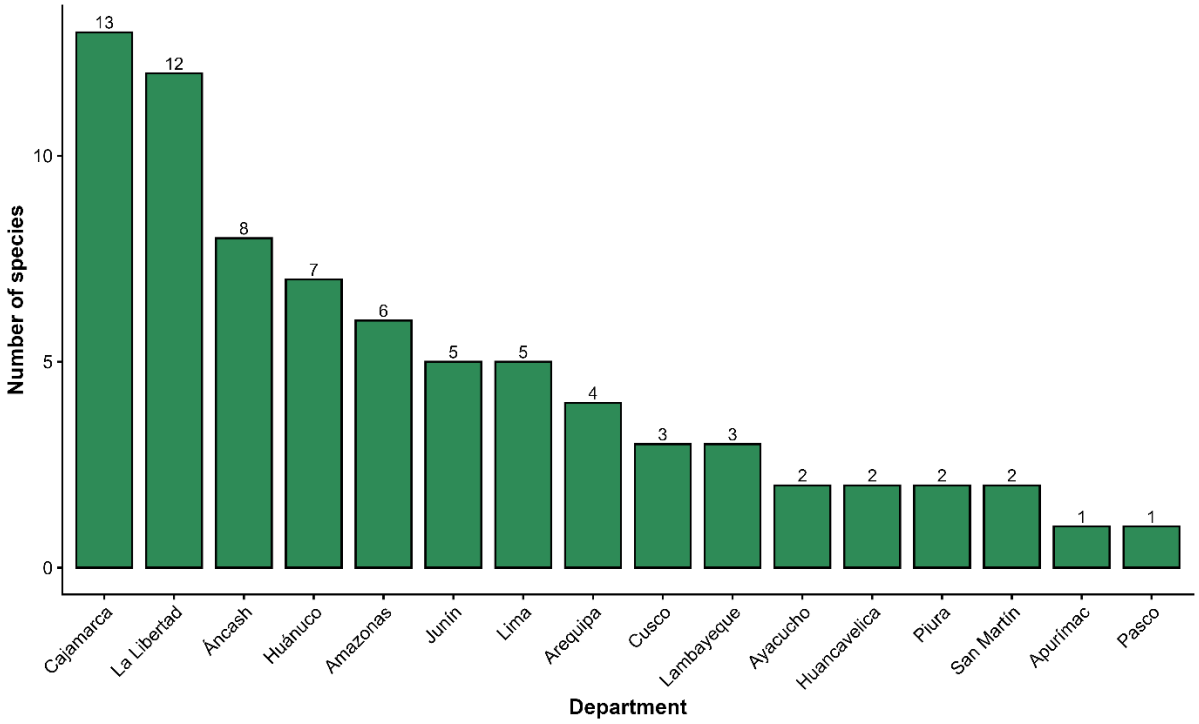


Figure 3: species frequency of endemic medicinal species presents by department in Peru.

Biological status, presence in local markets

The 96 identified species of medicinal plants belong to 43 botanical families. The families with the highest number of species were the Asteraceae, with 18 species; the Fabaceae and Gentianaceae, with seven species each; and the Bignoniaceae, Rosaceae, and Rubiaceae, with five species each. Additionally, 36 species were recorded in at least one market. In terms of management, 90 species are exclusively wild, five occur both in the wild and in cultivation, and one is only a cultivated species (Table 1).

Table 1: Species of medicinal plants that are under some degree of threat according to the International Union for Conservation of Nature, and D.S. No. 043-2006-AG. IUCN Red List Categories and Criteria (https://www.iucnredlist.org/es) (IUCN 2025). Departmental records of endemism, main threats, biological status, and market sales.

N. º	Species	Family https://powo.science.kew.org/	(IUCN, 2025)	Supreme Decree N. º 043-2006-AG (Ministerio de Agricultura, 2006)	Endemic (León et al., 2006)	Biological status (Supreme Decree N. º 043-2006-AG; IUCN, 2025)	Market sales	References (*studies included in the PRISMA review)
1	*Alnus acuminata* Kunth	Betulaceae	LC	VU	Not endemic	Wild/ Cultivated	Undetermined	Gonzales et al. (2014); Orrillo-Mejía (2018)
2	*Ambrosia dentata* (Cabrera) M.O.Dillon	Asteraceae	NE	CR	AR.	Wild	Undetermined	Kovács et al. (2022)
3	*Ambrosia pannosa* W.W. Payne	Asteraceae	NE	CR	AR.	Wild	Undetermined	Kovács et al. (2022)
4	*Aniba rosodora* Ducke	Lauraceae	EN	VU	Not endemic	Wild	Undetermined	Sœur et al. (2011)
5	*Aristeguietia ballii* (Oliv.) R.M.King & H.Rob.	Asteraceae	NE	NT	AR, LI.	Wild	Undetermined	Flores-Altamirano (2025)
6	*Aristeguietia discolor* (DC.) R.M.King & H.Rob.	Asteraceae	NT	NE	Not endemic	Wild	Undetermined	Hurtado-Huarcaya (2024)
7	*Arnaldoa macbrideana* Ferreyra	Asteraceae	NE	CR	LA, PI.	Wild	Undetermined	Ccana-Ccapatinta et al. (2019)
8	*Arnaldoa weberbaueri* (Muschl.) Ferreyra	Asteraceae	NE	CR	AM, CA, LL.	Wild	Undetermined	Ccana-Ccapatinta et al. (2019)
9	*Azorella compacta* Phil.	Apiaceae	LC	VU	Not endemic	Wild	Undetermined	Araya et al. (2003)
10	*Baccharis genistelloides* (Lam.) Pers.	Asteraceae	NE	NT	Not endemic	Wild	Present	Castañeda et al. (2021)*
11	*Banisteriopsis caapi* (Spruce ex Griseb.) C.V.Morton	Malpighiaceae	NE	NT	Not endemic	Wild	Undetermined	Schwarz et al. (2003)
12	*Barnadesia dombeyana* Less.	Asteraceae	NE	NT	Not endemic	Wild	Present	Castañeda et al. (2021)*; Silva-Alarcón et al. (2019)*
13	*Begonia veitchii* Hook.f.	Begoniaceae	NE	EN	Not endemic	Wild	Present	Castañeda et al. (2021)*
14	*Brugmansia arborea* (L.) Sweet	Solanaceae	EW	NE	Not endemic	Cultivated	Undetermined	Silva (2023)*

Table 1: Continued.

N. º	Species	Family https://powo.science.kew.org/	(IUCN, 2025)	Supreme Decree N. º 043-2006-AG (Ministerio de Agricultura, 2006)	Endemic (León et al., 2006)	Biological status (Supreme Decree N. º 043-2006-AG; IUCN, 2025)	Market sales	References (*studies included in the PRISMA review)
15	*Brugmansia sanguinea* (Ruiz & Pav.) D.Don	Solanaceae	EW	NE	Not endemic	Wild	Present	Silva (2023)*
16	*Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Sweet	Solanaceae	EW	NE	Not endemic	Wild	Present	Orrillo-Mejía (2018)
17	*Buddleja coriacea* J.Rémy	Scrophulariaceae	LC	CR	Not endemic	Wild	Undetermined	Apaza-Ticona et al. (2022)
18	*Buddleja incana* Ruiz & Pav.	Scrophulariaceae	LC	CR	Not endemic	Wild	Present	Silva-Alarcón et al.(2019)*
19	*Bursera graveolens* (Kunth) Triana & Planch.	Burseraceae	LC	CR	Not endemic	Wild	Present	Orrillo-Mejía (2018)
20	*Calceolaria engleriana* Kraenzl.	Calceolariaceae	NE	VU	CU	Wild	Present	Castañeda et al. (2021)*
21	*Cantua buxifolia* Juss. ex Lam.	Polemoniaceae	LC	NT	Not endemic	Wild	Undetermined	Vásquez et al. (2014)
22	*Morisonia scabrida* (Kunth) Christenh. & Byng	Capparaceae	LC	CR	Not endemic	Wild	Undetermined	Abreu-Naranjo et al. (2020)
23	*Cascabela thevetia* (L.) Lippold	Apocynaceae	LC	NT	Not endemic	Wild	Undetermined	Soni et al. (2024)
24	*Caxamarca sanchezii* M.O.Dillon & Sagást.	Asteraceae	NE	CR	CA, LL.	Wild	Undetermined	Vásquez & Salinas (2015)
25	*Ceiba insignis* (Kunth) P.E.Gibbs & Semir	Malvaceae	NE	NT	Not endemic	Wild	Undetermined	Abdel-Aziz et al. (2021)
26	*Ceiba pentandra* (L.) Gaertn.	Malvaceae	LC	NT	Not endemic	Wild	Undetermined	Chan et al. (2022)
27	*Chionanthus pubescens* Kunth	Oleaceae	LC	EN	Not endemic	Wild	Undetermined	Mihai et al. (2023)
28	*Chuquiraga jussieui* J.F.Gmel.	Asteraceae	NE	NT	Not endemic	Wild	Undetermined	Dueñas-Rivadeneira et al. (2014)
29	*Chuquiraga weberbaueri* Tovar	Asteraceae	LC	VU	AM, CA, LL, PI.	Wild	Present	Castañeda et al. (2021)*; Castillo-Vera et al. (2017)*

Table 1: Continued.

N. º	Species	Family https://powo.science.kew.org/	(IUCN, 2025)	Supreme Decree N. º 043-2006-AG (Ministerio de Agricultura, 2006)	Endemic (León et al., 2006)	Biological status (Supreme Decree N. º 043-2006-AG; IUCN, 2025)	Market sales	References (*studies included in the PRISMA review)
30	*Cinchona asperifolia* Wedd.	Rubiaceae	EN	NE	Not endemic	Wild	Undetermined	García et al. (2022)
31	*Cinchona calisaya* Wedd.	Rubiaceae	LC	VU	Not endemic	Wild	Undetermined	García et al. (2022)
32	*Cinchona glandulifera* (Ruiz) Ruiz & Pav.	Rubiaceae	CR	DD	HU, SM.	Wild	Undetermined	García et al. (2022)
33	*Cinchona hirsuta* Ruiz & Pav.	Rubiaceae	EN	NE	Not endemic	Wild	Undetermined	García et al. (2022)
34	*Cinchona pyrifolia* L.Andersson.	Rubiaceae	VU	NE	HU.	Wild	Undetermined	García et al. (2022)
35	*Clinopodium weberbaueri* (Mansf.) Govaerts	Lamiaceae	NE	NT	AN, CA, LL.	Wild	Present	De La Cruz-Castillo et al. (2024)
36	*Cochlospermum vitifolium* (Willd.) Spreng.	Bixaceae	LC	EN	Not endemic	Wild	Undetermined	Sánchez-Salgado et al. (2007)
37	*Columellia obovata* Ruiz & Pav.	Columelliaceae	NE	NT	Not endemic	Wild	Undetermined	Castañeda et al. (2021)*
38	*Copaifera paupera* (Herzog) Dwyer	Fabaceae	LC	VU	Not endemic	Wild	Undetermined	Mendoza & Chávez-Lozada (2019)
39	*Croton draconoides* Müll.Arg.	Euphorbiaceae	NE	NT	Not endemic	Wild	Undetermined	Salatino et al. (2007)
40	*Cybistax antisyphilitica* (Mart.) Mart.	Bignoniaceae	LC	VU	Not endemic	Wild	Undetermined	Gonçalves (2022)
41	*Desmodium molliculum* (Kunth) DC.	Fabaceae	NE	NT	Not endemic	Wild	Present	Castillo-Vera et al. (2017)* Silva-Alarcón et al. (2019)*
42	*Ephedra americana* Humb. & Bonpl. ex Willd.	Ephedraceae	LC	NT	Not endemic	Wild	Present	Castillo-Vera et al. (2017) *
43	*Ephedra rupestris* Benth.	Ephedraceae	LC	CR	Not endemic	Wild	Present	Castañeda et al. (2021) *
44	*Gentianella alborosea* (Gilg) Fabris.	Gentianaceae	EN	CR	JU.	Wild	Present	Evans et al. (2014)*

Table 1: Continued.

N. º	Species	Family https://powo.science.kew.org/	(IUCN, 2025)	Supreme Decree N. º 043-2006-AG (Ministerio de Agricultura, 2006)	Endemic (León et al., 2006)	Biological status (Supreme Decree N. º 043-2006-AG; IUCN, 2025)	Market sales	References (*studies included in the PRISMA review)
45	*Gentianella chamuchui* (Reimers) Fabris	Gentianaceae	NT	NE	AN, CA, LL.	Wild	Undetermined	Seminario et al. (2024)*
46	*Gentianella crassicaulis* J.S.Pringle	Gentianaceae	NE	VU	CA, CU, LL.	Wild	Present	Seminario et al. (2021)
47	*Gentianella dianthoides* (Kunth) Fabris ex J.S.Pringle.	Gentianaceae	NE	VU	AN, AY, CA, HU.	Wild	Present	Seminario et al. (2021)
48	*Gentianella eurysepala* (Gilg) Zarucchi	Gentianaceae	NE	EN	HV.	Wild	Present	Castañeda et al. (2021)*
49	*Gentianella sagasteguii* J.S.Pringle	Gentianaceae	VU	NE	Not endemic	Wild	Undetermined	Silva (2023)*
50	*Gentianella thyrsoidea* (Hook.) Fabris	Gentianaceae	LC	VU	AN, AY, HU, JU, LL, PA.	Wild	Present	Silva-Alarcón et al. (2019)*
51	*Geranium ayavacense* Willd. ex Kunth	Geraniaceae	NE	EN	Not endemic	Wild	Undetermined	Velasquez-Arevalo et al. (2020)
52	*Geranium sessiliflorum* Cav.	Geraniaceae	NE	EN	Not endemic	Wild	Undetermined	Velasquez-Arevalo et al. (2020)
53	*Gossypium raimondii* Ulbr.	Malvaceae	EN	CR	AM, CA, LA, LL	Wild	Undetermined	Seminario et al. (2024) *
54	*Haplorhus peruviana* Engl.	Anacardiaceae	EN	CR	Not endemic	Wild	Present	Castañeda et al. (2021) *
55	*Hemionitis nivea* (Poir.) Christenh.	Pteridaceae	NE	VU	Not endemic	Wild	Undetermined	Castañeda et al. (2021)* Silva-Alarcón et al. (2019)*
56	*Ismene amancaes* (Ruiz & Pav.) Herb.	Amaryllidaceae	NE	VU	AP, CA, CU, LI.	Wild	Undetermined	Soto-Vásquez et al. (2022)
57	*Jacaranda acutifolia* Bonpl.	Bignoniaceae	LC	VU	Not endemic	Wild	Undetermined	Chen et al. (2006)
58	*Jacaranda mimosifolia* D.Don	Bignoniaceae	VU	VU	Not endemic	Wild	Undetermined	Aguirre-Becerra et al. (2020)
59	*Jatropha humboldtiana* McVaugh	Euphorbiaceae	NE	VU	AM, CA.	Wild	Undetermined	Alvarado-García et al. (2025)

Table 1: Continued.

N. º	Species	Family https://powo.science.kew.org/	(IUCN, 2025)	Supreme Decree N. º 043-2006-AG (Ministerio de Agricultura, 2006)	Endemic (León et al., 2006)	Biological status (Supreme Decree N. º 043-2006-AG; IUCN, 2025)	Market sales	References (*studies included in the PRISMA review)
60	*Jatropha macrantha* Müll.Arg.	Euphorbiaceae	NE	VU	AN, AR, CA, HU, LI, LL.	Wild	Undetermined	Seminario et al. (2024)*
61	*Juglans neotropica* Diels	Juglandaceae	EN	NT	Not endemic	Wild/Cultivated	Present	Castañeda et al. (2021)*
62	*Kageneckia lanceolata* Ruiz & Pav.	Rosaceae	VU	CR	Not endemic	Wild	Present	Silva (2023)*
63	*Krameria lappacea* (Dombey) Burdet & B.B.Simpson	Krameriaceae	NE	EN	Not endemic	Wild	Present	Castillo-Vera et al. (2017)*
64	*Lomatia hirsuta* (Lam.) Diels	Proteaceae	LC	VU	Not endemic	Wild	Undetermined	Montoya-Quino et al. (2024)*
65	*Lupinus brachypremnon* C.P.Sm.	Fabaceae	NE	VU	AN, HU, JU, LI.	Wild	Present	Castañeda et al. (2021)*
66	*Oreopanax raimondii* Harms	Araliaceae	CR	EN	CA, LL.	Wild	Undetermined	Seminario et al. (2024)*
67	*Grimolobium mexicanum* (L.f.) A.N.Egan & C.H.Stirt.	Fabaceae	NE	CR	Not endemic	Wild	Present	Castillo-Vera et al. (2017)*; Montoya-Quino et al. (2024)*
68	*Grimolobium munyense* (J.F.Macbr.) A.N.Egan & C.H.Stirt.	Fabaceae	NE	CR	Not endemic	Wild	Undetermined	Montoya-Quino et al. (2024)*
69	*Mauria heterophylla* Kunth	Anacardiaceae	LC	VU	Not endemic	Wild	Present	Castillo-Vera et al. (2017)*
70	*Maytenus macrocarpa* (Ruiz & Pav.) Briq.	Celastraceae	LC	NT	Not endemic	Wild	Undetermined	Malaník et al. (2019)
71	*Mirabilis expansa* (Ruiz & Pav.) Standl.	Nyctaginaceae	NE	NT	Not endemic	Wild/ cultivated	Present	Cadena-Carrera et al. (2025)
72	*Monactis macbridei* H.Rob.	Asteraceae	NE	NT	Not endemic	Wild	Present	Castillo-Vera et al. (2017)*
73	*Mutisia acuminata* Ruiz & Pav.	Asteraceae	NE	NT	Not endemic	Wild	Present	Silva-Alarcón et al. (2019)*
74	*Mutisia wurdackii* Cabrera	Asteraceae	NE	VU	AM.	Wild	Undetermined	Paulo et al. (2023)

Table 1: Continued.

N. º	Species	Family https://powo.science.kew.org/	(IUCN, 2025)	Supreme Decree N. º 043-2006-AG (Ministerio de Agricultura, 2006)	Endemic (León et al., 2006)	Biological status (Supreme Decree N. º 043-2006-AG; IUCN, 2025)	Market sales	References (*studies included in the PRISMA review)
75	*Myrcianthes discolor* (Kunth) McVaugh	Myrtaceae	LC	CR	Not endemic	Wild	Present	Montoya-Quino et al. (2024)*
76	*Myrsine diazii* Pipoly	Primulaceae	VU	NE	AM.	Wild	Undetermined	Seminario et al. (2024)*
77	*Polylepis incana* Kunth	Rosaceae	LC	CR	Not endemic	Wild	Undetermined	Gonzales et al. (2014)
78	*Polylepis multijuga* Pilg.	Rosaceae	EN	EN	AM, CA, LA.	Wild/ cultivated	Undetermined	Seminario et al. (2024)*
79	*Polylepis racemosa* Ruiz & Pav.	Rosaceae	DD	CR	Not endemic	Wild	Present	Silva (2023) *; Silva-Alarcón et al. (2019)*
80	*Polylepis weberbaueri* Pilg.	Rosaceae	NT	VU	Not endemic	Wild	Undetermined	Gonzales et al. (2014)
81	*Puya fastuosa* Mez	Bromeliaceae	EN	NE	Not endemic	Wild	Undetermined	Silva (2023)*
82	*Puya raimondii* Harms	Bromeliaceae	EN	EN	Not endemic	Wild	Undetermined	Salazar et al. (2010)*
83	*Ranunculus giganteus* Wedd.	Ranunculaceae	VU	CR	AN, CA, LL, SM.	Wild	Present	Silva-Alarcón et al. (2019)*
84	*Ranunculus weberbaueri* (Ulbr.) Lourteig	Ranunculaceae	NE	VU	AN, HU, JU, SM.	Wild	Undetermined	Gonzales et al. (2014)
85	*Senecio gamolepis* Cabrera	Asteraceae	NE	VU	AR, HV, JU, LI.	Wild	Undetermined	Hurtado-Huarcaya et al. (2021)
86	*Senecio nutans* Sch.Bip.	Asteraceae	NE	VU	Not endemic	Wild	Undetermined	Palacios et al. (2023)
87	*Senecio rhizomatus* Rusby	Asteraceae	NE	VU	Not endemic	Wild	Present	Castañeda et al. (2021)*
88	*Senna cajamarcae* H.S.Irwin & Barneby.	Fabaceae	VU	NE	Not endemic	Wild	Undetermined	Silva (2023)*
89	*Smallanthus glabratus* (DC.) H.Rob.	Asteraceae	LC	CR	Not endemic	Wild	Undetermined	Seminario et al. (2024)*
90	*Swietenia macrophylla* King	Meliaceae	EN	VU	Not endemic	Wild	Undetermined	Moghadamtousi et al. (2013)

Table 1: Continued.

N. º	Species	Family https://powo.science.kew.org/	(IUCN, 2025)	Supreme Decree N. º 043-2006-AG (Ministerio de Agricultura, 2006)	Endemic (León et al., 2006)	Biological status (Supreme Decree N. º 043-2006-AG; IUCN, 2025)	Market sales	References (*studies included in the PRISMA review)
91	*Tara spinosa* (Molina) Britton & Rose	Fabaceae	LC	VU	Not endemic	Wild/ cultivated	Undetermined	Silva (2023)*
92	*Tecoma fulva* subsp. *arequipensis* (Sprague) J.R.I.Wood.	Bignoniaceae	NE	VU	Not endemic	Wild	Undetermined	Chávez-Fernández et al. (2020)
93	*Tecoma stans* (L.) Juss. ex Kunth	Bignoniaceae	NE	NT	Not endemic	Wild	Undetermined	Alguacil et al. (2000)
94	*Valeriana pilosa* Ruiz & Pav.	Caprifoliaceae	NE	CR	Not endemic	Wild	Present	Seminario-Cunya et al. (2016)
95	*Vasconcellea candicans* (A.Gray) A.DC.	Caricaceae	LC	CR	Not endemic	Wild	Present	Gutiérrez-Román et al. (2023)
96	*Vallea stipularis* L.f.	Elaeocarpaceae	LC	NE	Not endemic	Wild	Undetermined	Montoya- Quino et al. (2024)*

Legend: EW: Extinct in the Wild; CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; LC: Least Concern; NE: Not Evaluated; DD: Data Deficient. Biological status: W: wild; C: cultivated. Abbreviations for the departments of Peru: AM (Amazonas), AN (Áncash), AP (Apurímac), AR (Arequipa), AY (Ayacucho), CA (Cajamarca), CU (Cusco), HU (Huánuco), HV (Huancavelica), IC (Ica), JU (Junín), LA (Lambayeque), LI (Lima), LL (La Libertad), MD (Madre de Dios), MO (Moquegua), PA (Pasco), PI (Piura), PU (Puno), SM (San Martín), TA (Tacna), UC (Ucayali) and LO (Loreto).

DISCUSSION

In this study, we identified 96 species of medicinal plants that are threatened to some degree; of these, 53 species were identified through a review of the 777 wild species listed in Supreme Decree No. 043-2006-AG, while the remaining 43 species were identified through a systematic review. Studies on the conservation of medicinal plants in Peru remain limited, as we identified only nine studies that directly address this topic. This pattern aligns with the findings reported by Angulo-Bazán (2020), who, after analyzing 200 articles indexed in Scopus, found a marked concentration of research in pharmacology and toxicology (27.0%) and medicine (22.7%), without explicitly detailing the proportion of studies focused on conservation; however, it is likely that these are included within ethnobotanical studies, which account for just 5.5% of the total.

Our study stands out for its scope, both in terms of the number of species recorded and the geographic coverage analyzed. In contrast, studies focused on the conservation of medicinal plants in Peru have generally been more limited in scope. For example, in the Andean district of Lircay, in Huancavelica, 13 threatened species were reported (Castañeda et al*.,* 2021); in the department of Cajamarca, 59 medicinal species were identified as being in some category of threat (Seminario et al., 2024), while in the district of Cajabamba (Cajamarca), nine medicinal species were recorded (Castillo-Vera et al., 2017).

Likewise, in a montane forest in the district of Chugur, also in Cajamarca, eight threatened medicinal species were documented (Montoya-Quino et al., 2024), and in the Amazon region that includes Peruvian territory, 11 medicinal species in this condition were reported (Lima et al., 2016). In urban settings, markets in Metropolitan Lima harbour at least 18 threatened medicinal species (Silva-Alarcón et al., 2019), while 20 medicinal species have been identified in the markets of Chiclayo and Trujillo (Evans et al., 2014). Meanwhile, in the Jalca region of Cajamarca, 11 medicinal species with some degree of threat were recorded (Silva, 2023). Added to this is the case of *Puya raimondii*, a medicinal plant and an emblematic species of the Andes whose conservation status has been documented in specific studies (Salazar et al., 2010).

Differences in the categorization of medicinal plant species, both globally and nationally, may stem from criteria applied to national contexts; the risk may appear exaggerated because the assessment is limited to a fraction of the species' total population, which may be small within a single country but form part of a larger population within its global range. The inclusion of variables associated with conservation priorities, the degree of endemism, or the size of the territory (Brito et al., 2010; Miller et al., 2007). However, regional and national Red Lists provide information at a scale appropriate for international conservation treaties. Nevertheless, it has been recommended to enhance transparency in national assessments by publishing complete lists of assessed species and explicitly addressing uncertainty (Brito et al., 2010; IUCN, 2025).

In Peru, Supreme Decree No. 043-2006-AG establishes the official classification of nationally threatened wild plant species (Ministerio de Agricultura, 2006). However, this document does not provide information on geographic distribution, population size, or specific threats. The same applies to the Red Book of Endemic Plants of Peru (León et al., 2006). Furthermore, both instruments were developed in 2006 and are in need of updating.

Of the 96 species identified in this study, 90 come from wild populations, confirming a marked reliance on direct collection in traditional systems of medicinal plant use. This trend has been documented in various regions of the country. In the markets of Trujillo and Chiclayo, nearly 500 species were recorded, of which only 76 were cultivated (Bussmann & Sharon, 2009). Similarly, in Lircay, Huancavelica, all 72 identified species were wild-collected (Castañeda et al., 2021). In the department of Cajamarca, 69% of the 1,115 recorded species come from natural environments (Seminario et al., 2024), while in Cajabamba this proportion reaches 63% of 123 species (Castillo-Vera et al., 2017). Likewise, at the Callejón de Huaylas market in Áncash, the majority of the 178 species collected also come from the wild (Gonzales et al., 2014). This pattern highlights the urgency of implementing sustainable management frameworks, such as the guidelines developed by the World Health Organization, IUCN, and WWF, as well as TRAFFIC's recommendations and Good Agricultural and Collection Practices (GACP). These guidelines propose a comprehensive approach that encompasses ecosystem management, sustainable collection, domestication and cultivation, and the assurance of equitable relationships among the stakeholders involved (Leaman, 2006).

The results show that the vulnerability of Peruvian medicinal plants depends not only on their threat category, but also on the interaction between endemism, their biological status, and their presence in local markets. Endemic species, due to their restricted geographic distribution, tend to be more susceptible to changes in land use and other environmental disturbances, which underscores the importance of their conservation (León et al., 2006). Likewise, the predominance of wild species indicates that most of the recorded medicinal plants come from natural populations, while the small number of cultivated species suggests that domestication represents a conservation strategy that remains underdeveloped (Bussmann & Sharon, 2009; Seminario et al., 2024). In addition, the presence of 36 species in local markets confirms that they are part of traditional use and trade networks; however, this information alone does not allow us to infer the magnitude of harvesting pressure on their natural populations. Consequently, species that combine a high threat level, endemic distribution, a predominantly wild status, and presence in markets constitute a priority group for future research aimed at assessing the impact of harvesting on their populations and guiding sustainable management and conservation strategies.

CONCLUSIONS

Our results identified 96 native medicinal species in Peru that face some degree of threat to their conservation. The high proportion of wild species and endemic taxa underscores the importance of strengthening research, monitoring, and conservation efforts, with special attention to species with restricted ranges and higher threat categories. Furthermore, the presence of some of these species in markets, along with the predominance of wild populations, highlights the need to promote sustainable use strategies and evaluate alternatives such as cultivation to contribute to their conservation and reduce potential dependence on natural populations.

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DECLARATIONS

Research permit(s). Not applicable.
Ethical approval/statement. Not applicable.
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