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Native language resources can illuminate global darkspots in utilized plant species and reduce data shortfalls

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The 2022 IPBES Sustainable Use of Wild Species Assessment states that humans collectively utilize about 31,100 plant species globally, roughly 7 percent of all described plant species. This is a conservative estimate acknowledged in the Assessment but is not clearly mentioned in the Summary for Policymakers report. This number is drawn from the Kew's State of the World's Plants and Fungi Reports, where the knowledge gap of species used and valued by humans in many regions (plant darkspots) is acknowledged. This article discusses this gap and its perpetuation while highlighting that Indigenous, Local, and Traditional Ecological Knowledge can remediate such global biodiversity data shortfalls. We propose that oral and written native language resources could enhance understanding and data coverage of species use, especially in biodiversity darkspots. To support this, we examine how native language resources have supported the documentation of species use in five countries—India, Brazil, Türkiye, Mexico, and Vietnam. Finally, we discuss barriers and opportunities, and call for policymakers, data managers, and other beneficiaries to systematically include native language resource insights, starting from the local and national levels and moving toward global aggregation.

KEYWORDS

IPLC, indigenous and local knowledge (ILK), traditional ecological knowledge (TEK), plant use knowledge, native language resources, plant darkspot

1 Introduction

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Assessment Report on the Sustainable Use of Wild Species (herein referred to as IPBES Sustainable Use Assessment) (IPBES, 2022c) represents one of the most comprehensive global efforts to document and quantify the rich socio-cultural heritage of human knowledge on species use. The assessment provides a best estimate of around 50,000 known species used by humans, of which there are 31,100 plants, 16,700 animals, and 1,500 fungi species. The Assessment acknowledges the conservativeness of these estimates. However, this caveat is not clearly mentioned in the Summary for Policymakers report. This may risk leading policymakers, scientists, and other report users to interpret these numbers as definitive rather than conservative, potentially undermining the ongoing efforts still needed to comprehensively document global species use.

In this Perspective paper, we examine the IPBES Sustainable Use Assessment in more detail, focusing on the methodology underlying the estimations of plant species use and identifying the associated knowledge gap. We contemplate shortfalls in current estimations, and showcase using case studies of different countries the potential of Indigenous, Local, and Traditional Ecological Knowledge (ILK & TEK) embedded within native language resources for filling such a knowledge gap. Finally, we discuss the challenges, solutions, risks and urgency to close the knowledge gap, and call for scientists, policymakers, Indigenous People and Local Communities and international knowledge hubs to collaborate to streamline native language resources at all levels of decision-making.

2 Knowledge gap of utilized plant species

The IPBES Sustainable Use Assessment reviewed that humans collectively use around 31,100 plant species (IPBES, 2022b). Methodologically, the total estimates of utilized plants are aggregated across use categories such as food, medicine, raw material and feedstock, agricultural feed, timber and other social uses. Statistics on utilized plant species were extracted and compared across major global databases, such as the IUCN Red List of Threatened Species. The Kew Botanical Garden's State of the World Plants reports, and World Flora Online (IPBES, 2022c).

The total estimate for utilized plant species was taken from the 2016 Kew's State of the World's Plants Report, which recorded 31,128 utilized plant species (IPBES, 2022b; Kew Royal Botanic Gardens, 2016). This number was based on a list of ten large regional and purpose-specific datasets (Diazgranados et al., 2018). In 2020, three additional large datasets were added to the list, substantially increased the total record of useful plants to 40,283 species (Diazgranados et al., 2020). The increase of nearly 10,000 records of useful plant species—an additional one-quarter of the initial estimate—suggests that even the most comprehensive lists of utilized species knowledge are largely incomplete.

Large databases compiled from sources with coarse regional representativeness tend to result in regional knowledge gaps and underestimations of utilized plant species, especially in areas where data is less available. As a result, global resources such as Kew's databases are useful to provide a conservative overview of the global state of species use, with the nuances that such knowledge is likely underestimated in most regions. The comprehensiveness of global databases ultimately relies on the geographic and taxonomic representativeness of the source datasets. In some cases, these source datasets may have been compiled using smaller, area-specific lists, presenting scattered snapshots of species use knowledge in a specific region. Current progress indicates that much more knowledge is needed to account for the severe under-representations of species knowledge in the countries not covered by the large datasets. For instance, the Medicinal Plant Name Services (MPNS), the largest database of medicinal plants underlying Kew's global knowledge of utilized plant species, only considers two references of Vietnamese medicinal plants, each of which listed about 200 species (MPNS Resources V14, 2024), in contrast to at least 3,000 documented medicinal plant species used in the country (Vo, 2021).

The 2023 Kew's State of the World Plant and Fungi Report acknowledges this systematic and regional knowledge gap as plant "darkspots"—areas predicted to contain the most species unknown to science (Antonelli et al., 2023). The report identifies 32 plant darkspots worldwide, most of which are countries or regions located within biodiversity hotspots and areas with rich cultural heritage (Figure 1). The darkspots are home to plants unknown to science that potentially make up an estimated 15% of the total flora diversity (Ondo et al., 2024). The plant darkspots reflect both a lack of data collection effort and a lack of scientific knowledge of the rich biodiversity as well as the traditional knowledge contained within these locations.

3 Native language resources have the potential to fill the knowledge gap on utilized plant species

Often available only in native language resources, ILK & TEK hold vast, untapped potential for Indigenous People and Local Communities (IPLCs) protagonism in uncovering more knowledge of species use. Languages are repositories of important biodiversity knowledge; for instance, medicinal plant knowledge is often linguistically unique (Cámara-Leret and Bascompte, 2021). At the same time, biodiversity (including plant diversity) and human languages are interconnected, and both are facing critical threats (Anderson et al., 2022). Estimates suggest that half of the languages currently spoken in the world are disappearing by the end of the century (Harrison, 2008). Language loss ultimately results in the loss of knowledge and values of nature that reciprocally sustain biodiversity (Anderson et al., 2022). By valuing and preserving native languages, we protect the rich tapestry of the world's cultural heritage and ensure that future generations inherit a world that is linguistically, culturally and biologically diverse. The IPBES Methodological Assessment of the Diverse Values and Valuation of Nature (IPBES, 2022a) recognizes a policy and knowledge gap in articulating and coordinating efforts into language revitalization, and biodiversity studies and inventories. Thus, the well-documentation of ILK & TEK can simultaneously enhance current scientific knowledge of utilized species, safeguard traditional knowledge, and support the revitalization of human languages.

Here, we present the approaches to managing ILK & TEK in the context of utilized plant species of five countries—India, Vietnam, Brazil, Mexico, and Türkiye (Figure 1). These countries are among those with the highest knowledge gap in utilized plant species in Asia, Latin America, and Europe (Ondo et al., 2024), and where new plant species are most rapidly scientifically discovered (Cheek et al., 2020). Additionally, they represent diverse biogeographic zones, linguistic contexts, and levels of ethnobotanical documentation.

We adopted a collaborative, expert-informed comparative case study approach (Yin, 2017). Through the IPBES fellow network—an international network of outstanding, interdisciplinary early-career researchers working on biodiversity issues—we assembled a team of researchers with context-specific expertise of the five

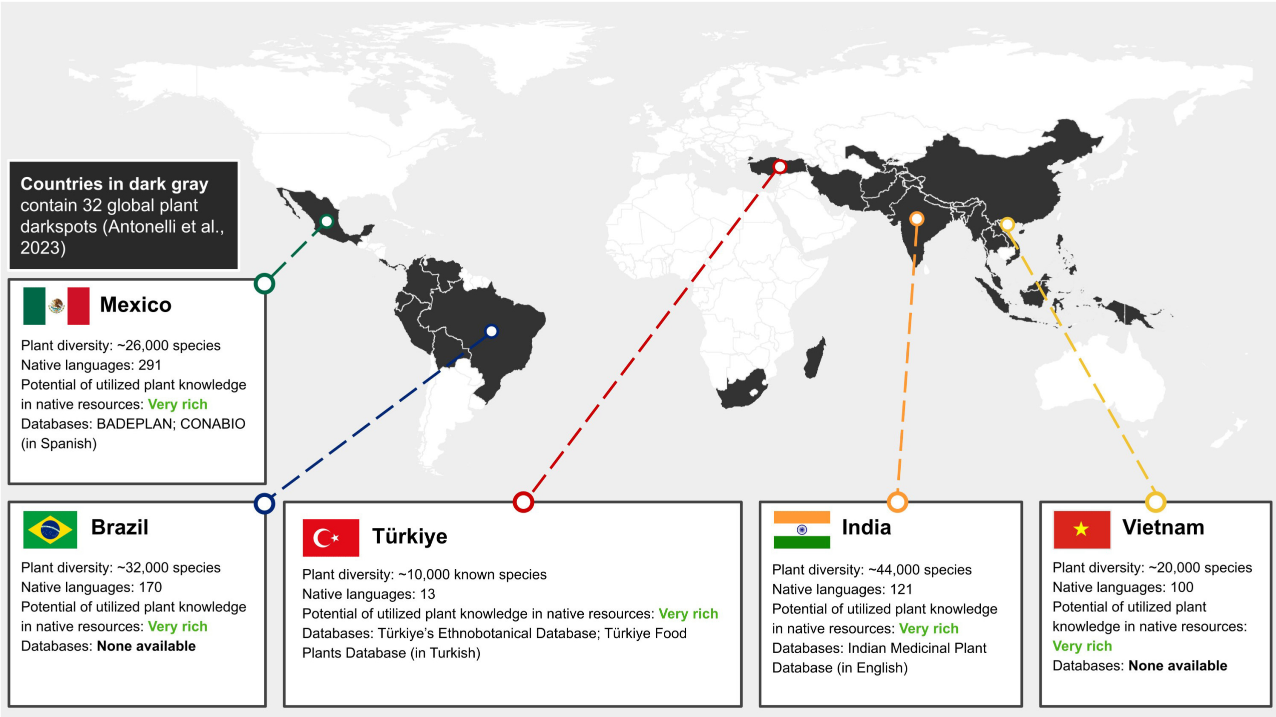

FIGURE 1
Location and key features of the case studies mapped against global plant diversity darkspots. Colored dots denote the five case studies compiled in this article. The areas in dark gray denote 32 global plant diversity darkspots, based on Antonelli et al. (2023), including: Asia-Tropical region (Myanmar, Assam, Philippines, Vietnam, Bangladesh, New Guinea, India, East and West Himalaya, Thailand, Sumatra, Laos, Peninsular Malaysia and Borneo); South America (Colombia, Peru, Venezuela, Bolivia, North and Southeast Brazil, Ecuador, Costa Rica and Panama); Asia-Temperate region (South-Central and Southeast China, Türkiye, Iran, Uzbekistan, and Tadzhikistan); Africa (Madagascar and Cape Provinces); and North America (Southwest Mexico). Boundaries represent an entity with an ISO code, which should not be used to imply a country's officially recognized territory. Map data was retrieved from GADM (https://gadm.org/).

countries. Each author conducted a country-specific scoping review of native language resources and scientific literature, including national and regional ethnobotanical databases, peer-reviewed studies, and digitized traditional manuscripts, drawing on individual and external expert knowledge where necessary. For example, the author responsible for the India case was directly involved in the management of plant use databases; in other cases, the authors may need to consult leading experts in the country. The method was intentionally designed to be flexible to accommodate unique differences in documented plant-use knowledge and each country's progress in standardizing native-language data. Since there is no publicly accessible statistics on the number of utilized plant species by country and use, except for food, we cannot provide a structured comparison of the potential of native language resources to the global databases for most case studies. Nevertheless, this approach enabled us to highlight qualitatively the potential contributions of ILK & TEK embedded in native resources, and to identify the challenges to their standardization into global knowledge of utilized plant species (Figure 1 and Table 1).

3.1 India

India is one of the megadiverse countries with 2.4% of the global land area. It has a list of 44,500 plant species which include 22,108 Angiosperms, 83 Gymnosperms, 1,319 Pteridophytes, 2,819 Bryphotes, 3,044 Lichens, 15,701 Fungi, 9,035 Algae and 1,278 Virus/Bacteria, representing 7% of the plants of the world, 28% of which are endemic to India (Botanical Survey of India, n.d.). India has 121 major languages of which 30 are spoken by more than one million native speakers.

The University of Trans-Disciplinary Health Sciences and Technology (TDU) has compiled a database of 6,580 botanicals of medicinal plant species, linked with 200,000 vernacular names in 32 regional languages (Venugopalan Nair et al., 2020). The data was collected through direct interaction with diverse indigenous communities and by browsing available documents from oriental libraries throughout the country. The database is available online in English (https://www.medicinalplants.in/). In 2020, the Medicinal Plant Name Services retrieved 6,024 plant species from this database. Much of India knowledge of utilized plant species remains undocumented. For example, the Northeast region of India remains an understudied region for both botanical and traditional knowledge studies. The TDU is working on a catalog of 17,000 medicinal manuscripts in 16 languages, which can potentially be used to derive information about other utilized plant species in India (Shankar, 2019). Only one percent of the manuscripts has been translated, leading to paucity of knowledge on description and distribution of the plant species. This makes connecting the translated documents on plant use with the current binomial botanical nomenclature challenging.

TABLE 1 Supporting evidence of knowledge from native language resources can fill in current knowledge gaps of utilized plant species in global databases.

Case study	Supporting evidence	References
India	• Kew's MPNS database retrieved 6,024 medicinal plant species out of 6,581 species from the TDU database. • The TDU database currently covers only a fraction of India's utilized plant species. • TDU has 17,000 manuscripts, only 1% of which has been transcribed into documented plant use.	(MPNS Resources V14, 2024; Shankar, 2019)
Brazil	• In 3 native language resources, 48 utilized plant species not listed in Kew's databases. • Knowledge of plant use richly available in native language resources, but scattered.	Supplementary Data 1
Türkiye	• At least 1,000 edible species are documented in native resources, in contrast to 300–500 species listed in Kew's databases. • 2884 utilized plant taxa documented in native language databases.	(Bellikçi Koyu, 2020; Çorbaci and Ekren, 2022)
Mexico	• 7,823–11,500 useful plant species are documented in native language databases, 25–37% of the total number in Kew's databases. • Only resources of 32 out of 68 main linguistic groups have been studied.	(Caballero et al., 2023)
Vietnam	• At least 3,000 medicinal plant species are documented in native language resources, in contrast to 200–400 medicinal species listed in key references of Vietnamese medicinal plants used by the Kew's MPNS database. • Knowledge of plant use is richly available in native language resources, but scattered.	(MPNS Resources V14, 2024; Vo, 2021)

Furthermore, India has implemented the Traditional Knowledge Digital Library—an effort to protect the rights of traditional knowledge holders—which has documented and preserved more than 454,000 formulations and practices transcribed from Indian traditional medicinal knowledge.

3.2 Brazil

Brazil is a megadiverse country, both in terms of biological and ethnocultural diversity. It is estimated that the country hosts about 15 to 20% of the world's biological diversity (CBD, n.d.). In the last decades, there has been a considerable effort put into cataloging Brazil's plant species: 1,471 seed plant species have been added to the national list of known plant species since 2010, summing up 32,109 native species, of which 18,423 species are endemic (Kew Royal Botanic Gardens, 2016; Martinelli and Moraes, 2013). The national list also included many synonyms of species names, contributing to avoiding duplication and improving its quality as a reference source of information on Brazilian flora. Regarding ethnocultural diversity, Brazil is also home to over 1,800 communities identified as local or traditional communities, including around 210 indigenous ethnic groups, speaking 170 languages (CBD, 2013).

Such a scenario highlights the huge potential of ILK & TEK systems as sources of information on plant use. Indeed, in just 3 case studies, we found 48 plant species used by IPLCs that are not documented in two of the main global databases on species use, the Kew's Medicinal Plant Names Service and Kew's Economic Botany Collection. In 2015, the Yanomami indigenous association in the northern Brazilian Amazon, Hutukara, published for the first time an illustrated book on their traditional medicine, in the Yanomami language with translation to Portuguese (Yanomami et al., 2015). From the 101 plant species documented, 32 species, i.e., approximately one third of the species, are not listed in Kew's databases. Echer et al. (2021) registered 12 species of wild, underutilized, and neglected edible plants used by family farmers from Canguçu, Cerrito and Pelotas, in southern Brazil, that are not documented in the databases. Similarly, Negreiros (2017) registered another 4 plant species used as fuel, food, wood, medicine, and body painting by the Jenipapo-Karindé Indigenous People in northeastern Brazil. Overall, native resources on local use of wild plants in Brazil are abundant but scattered, which makes it challenging to estimate how much knowledge is already documented. Efforts to produce a national inventory of wild plant use would contribute the most to bridging this gap.

3.3 Türkiye

Türkiye harbors 11,707 vascular plant taxa and 9,996 plant species, making it one of the most floristically rich countries in Europe. Approximately 32% of these species are endemic (Güner et al., 2012). Globally, there are an estimated 350,000 plant species (Antonelli et al., 2023), while Europe hosts around 20,000 species (Holz et al., 2022). Türkiye contains ~2.9% of the world's plant species and 50% of Europe's total plant diversity, highlighting its critical role in regional and global floristic biodiversity.

There are no communities in Türkiye recognized as 'indigenous peoples' under international criteria. There are 13 languages spoken in Türkiye (KONDA, 2006). The constitution ensures equal rights for all citizens, including the protection and preservation of traditional knowledge systems. In this regard, the National Project for the Documentation of Biodiversity-Based Traditional Knowledge has been completed, facilitating the systematic documentation and sustainable transmission of TEK.

TEK in Türkiye is preserved through written records and oral traditions. Ottoman-era manuscripts documenting the medicinal and economic uses of plants remain valuable ethnobotanical sources. According to Türkiye's Ethnobotanical Database, 2,884 plant taxa have documented traditional uses (Bellikçi Koyu, 2020). The Türkiye Food Plants Database reports 1,604 taxa used for food (Urhan et al., 2016). Edible plant species constitute ~10% of Türkiye's flora (Çorbaci and Ekren, 2022). These figures suggest that there are at least 1,000 edible species in Türkiye. Globally, an estimated 7,000 edible plant species exist (Khoshbakht and Hammer, 2008), implying that Türkiye contributes at least 14% of the world's food plant diversity, underscoring its biocultural significance.

Despite this rich knowledge base, modernization, urbanization, and limited digital access pose challenges to the sustainable transmission of TEK. Most ethnobotanical databases and academic studies in Türkiye are in Turkish, limiting international accessibility and integration into global biodiversity datasets. Although some studies are available in English, standardization remains an issue.

To enhance TEK visibility and conservation, digitization efforts, international collaboration, and bilingual knowledge systems should be prioritized. Integrating Türkiye's ethnobotanical data into global databases will strengthen biodiversity conservation efforts and promote the sustainable use of traditional knowledge on a broader scale.

3.4 Mexico

Mexico is the 5th most megadiverse countries in the world, and is inhabited by diverse cultures that speak nearly 291 languages (Eberhard et al., 2025), clustered into 68 main linguistic groups. These two characteristics (biodiversity and cultures) create an outstanding biocultural diversity, including ethnobotanical knowledge.

A significant number of studies in this field have been systematized under the Database of Ethnobotanical Information of Mexican Plants (BADEPLAN, for its acronym in Spanish) from the Botanical Garden at the Institute of Biology at the National Autonomous University of Mexico (UNAM). BADEPLAN is considered the most complete inventory of plant use and management in the country, however its access is restricted. This database started around 40 years ago with the efforts of Dr. Javier Caballero, followed by a group of collaborators, and to date it has nearly 60,000 records of plants and their uses (Caballero et al., 2023). The current number of species reaches 7,823 useful plants, but estimates through different approaches have a larger figure of 11,500 species. The difference between figures is partly because only 32 of the 68 main linguistic groups of the country have been studied, and research has focused on specific geographic areas corresponding to half of the country's states (Caballero et al., 2023). This situation highlights the significant efforts still needed to document and revitalize ILK & TEK around plant use.

Other country-wide inventories of biodiversity, including plant use, are those of the National Commission for the Knowledge and Use of Biodiversity (CONABIO, for its acronym in Spanish). Access to various databases from CONABIO are public, including distribution maps and images of plants. It currently has a total record of 6,482 useful plant species. Despite CONABIO databases compiling a significant amount of biodiversity information at the country level, information gaps are recognized (Sarukhán et al., 2015). For example, information on the website is only available in Spanish and not in other indigenous languages.

Despite great efforts to document and revitalize plant use in Mexico have been done, maintaining local databases such as BADEPLAN and CONABIO need permanent resources (human and economic) to be up to date and increasing. In addition, strategies to document and revitalize plant use in native languages require extra efforts. Usually, researchers are those who allocate resources to compile and disseminate ILK without a national strategy to cover the territory.

3.5 Vietnam

Vietnam is the 25th most biodiverse country in the world, home to more than 60,000 species, 21 of the world's 25 biomes, and 60 of the world's 108 ecosystem functional groups (NBCA, 2022; Thuaire et al., 2021). According to various sources, 17,000 and 20,000 plant species have been recorded in Vietnam (NBCA, 2022; Thuaire et al., 2021). Over the past decade, more than 50 new species or records have been published annually, suggesting Viet Nam's vascular plant diversity exceeds earlier estimates (Middleton et al., 2019). About 30% of Vietnam's plant species are endemic (NBCA, 2022), implying that many utilized species are not found outside the country.

Vietnam's first integrated National Biodiversity Database System (NBDS) was only available in 2016, following collaboration between the Vietnamese authorities—the Nature and Biodiversity Conservation Agency (BCA) under the Ministry of Natural Resources and the Environment (MONRE) and the Japan International Cooperation Agency (JICA). The NBDS infrastructure allows local institutions to link biodiversity data to the Global Biodiversity Information Facility (GBIF) (GBIF.org, 2025). The NBDS database currently contains 27,210 animal and plant taxa, nearly half of the national inventory, recorded from 35 datasets of national reserves and protected areas in Vietnam (NBCA, n.d.).

Similar to the approach to producing biodiversity checklists, survey data on utilized species is conducted at the level of natural protected areas and often focuses on a specific indigenous ethnic group. Various studies list hundreds to thousands of plant species used in a locality, for example, 208 non-medicinal plants in Ben En National Park (Van Hoang et al., 2008), 373 edible plant species in Pu Huong Nature Reserve (Pu Huong Nature Reserve, 2024); 207 medicinal plants used by the Dao people in Ba Vi National Park (Van On et al., 2001); 1,692 utilized plants in Ba Vi National Park (Ba Vi National Park, n.d.). In some cases, many species have a local name and are commonly foraged by the local indigenous people as food, but local researchers are unable to identify scientific names (Vu and Nguyen, 2017). Given that there are 54 different ethnicities and more than 100 spoken languages in Vietnam (Le Ha et al., 2014), spreading throughout the country's hundreds of natural protected areas, these studies only contribute a modest portion of ILK & TEK in Vietnam (MONRE, 2011).

Efforts to provide more comprehensive lists at the country level exist, although the lists are only available in native documentations. For example, VIETHERB is a dataset for herbal plants in Vietnam containing 2,881 plant species (Nguyen-Vo et al., 2019); national record documents at least 3,830 medicinal species (NBCA, 2022). Vo (2021) contains the most extensive list of medicinal species based on folk and traditional knowledge, including 4,700 plants and fungi. These figures, only covering medicinal plants in Vietnam, account for 8 to 13% of the total estimated number of plants utilized globally.

3.6 The scientific (re)discovery of locally used species

New scientific discovery of already locally used plant species is not uncommon. Even now, species traditionally utilized by the indigenous and local communities are rapidly being described as new species by scientists. For example, *Staurogyne yamokmehong*, traditionally used by the Shan Ni people of Myanmar as a hormone regulator, was scientifically named in 2022 (Antonelli et al., 2023). *Pinanga subterranea* is a palm species in Borneo widely used by the local people for its edible fruits, and was described by scientists in 2023 (Kuhnhäuser et al., 2023). *Ipomoea noemana*, described in 2020, is an endemic species in Peru known by the Indigenous people in the high Andes as 'yura' and traditionally used as an edible food source (Cheek and McLeod, 2020). The sumac (*Rhus coriaria*), a widely used spice in Türkiye and the Middle East, has been valued in folk medicine for its antimicrobial and digestive benefits for centuries (Khoshkharam et al., 2020). In Türkiye, traditional species like orchid tubers (*Orchis* sp.) used in local ice cream (Turkmen, 2021), knotweed (*Polygonum cognatum*) used in cuisine (Coban et al., 2021), and Mediterranean thyme (*Thymbra spicata*) used as spice and antimicrobial (Gedikoglu et al., 2019), have only recently gained scientific recognition. In 2025, scientists described a deep-sea giant isopod species, *Bathynomus vaderi*, which Vietnamese people locally use as a delicacy (Ng et al., 2025). These cases emphasize that many utilized species are unknown to science but well familiar to ILK & TEK. Additionally, ILK & TEK can contribute to better species classification. In 2022, molecular studies confirmed what the Iban and Dusun peoples have long recognized as two distinct fruit tree species, *Artocarpus odoratissimus* and *Artocarpus mutabilis*, previously classified as one in Linnaean taxonomy (Gardner et al., 2022). Thus, ILK & TEK represents a valuable venue for elevating scientific understanding of new species and their contributions to humans.

4 Discussion and concluding remarks

Our case studies confirm the limitations in existing global databases of utilized plant species, with a vast knowledge gap in utilized plant species in plant biodiversity darkspots that warrants serious consideration. For instance, Türkiye's case study identifies more than 1,000 edible plant species, whereas Kew's global database includes only 300–500 species (Kew Royal Botanic Gardens, 2020). These case studies point to the undeniable potential of ILK & TEK in elevating scientific knowledge of plants useful to humans, which is often already richly embedded within native oral and written resources. It is crucial to improve access and usability of the rich ILK & TEK at the global level, by enhancing efforts to mainstream, document, and standardize this knowledge. Efforts in countries like India, Türkiye, and Mexico exemplify progress in harnessing, digitalizing, and generating databases of ILK & TEK, offering models for other countries where such work is still nascent, such as Vietnam and Brazil.

Nevertheless, two important challenges persist. First, ILK & TEK often lack a formal recognition in scientific endeavors and policy decision-makings. Increasing awareness through communication and mainstreaming of ILK & TEK-related knowledge gaps, including those identified in global initiatives such as IPBES (IPBES, 2022a,c), can help stakeholders recognize the value of ILK & TEK. Second, linguistic barriers remain a critical constraint. In some cases, the use of rare or minority languages impedes integration into standardized databases. In others, established databases are only available in the dominant national languages (e.g., Spanish, Turkish, and Vietnamese), limiting broader accessibility. To overcome this challenge, it is imperative that ILK & TEK data collection and standardization processes involve multi-stakeholder collaborations, including traditional ecological knowledge holders, local researchers, policymakers and international initiatives, with the explicit aim to empower IPLCs by helping them steward their biocultural heritage and not the opposite (Arias-Arévalo et al., 2023). Crucially, such efforts must be grounded in the principles of Free, Prior, and Informed Consent to ensure that the rights, agency, and benefits of knowledge holders are respected. In doing so, ILK & TEK can be made more accessible and actionable across spatial scales and governance contexts, while safeguarding ethical standards and community sovereignty.

Immediate actions and strategies to revitalize ILK & TEK are crucial, given the rate at which languages and biodiversity, including ethnobotanical knowledge, are being lost (Copete et al., 2023). For example, researchers in the Ixcatec indigenous region in Oaxaca, Mexico document more than 500 useful plant species and create a game in the almost extinct local Ixcatec language, a photo contest and other activities, aiming at motivating young people in the community to rescue, value and transmit this knowledge to the wider community (Aguilar et al., 2016). Art expressions, traditional celebration enhancement and oral documentation of stories are examples of creative approaches to incentivize and foster IPLCs protagonism and stewardship for nature conservation.

Overlooking the systemic knowledge gap on utilized plant species can potentially risks introducing biases into scientific analyses and policy implications. For example, Pironon et al. (2024) in a comprehensive global study, mapped plant use by integrating 12 databases and over 11 million geo-referenced records for 35,687 species. They found no higher concentrations of documented plant use in Indigenous territories compared to adjacent non-Indigenous areas, attributing this to the historical displacement of Indigenous People from their original land. While plausible, an alternative explanation lies in uneven data availability—particularly in megadiverse, culturally rich regions—potentially skewing results. Although the authors noted lower data occurrences in these areas, they did not fully consider how these data gaps may critically undermine meaningful comparisons of utilized plant species richness between Indigenous and non-Indigenous regions. Furthermore, such systematic knowledge gap can also lead to far-reaching and serious consequences, including underestimating the values of nature contributions to humans; misguiding conservation priorities and inequitable policy decisions away from diverse and culturally significant regions that are not well-documented; unaware of the erosion of biocultural heritage that are parts of IPLCs identities, which weaken their rights and claims to land and knowledge systems; and a loss of opportunity to leverage the sustainable use of a diverse range of species in support of the multi-dimensional and interconnected global sustainable goals, including poverty, sustainable food system, and climate change.

To conclude, filling in the global knowledge gap of utilized plant species requires substantial efforts to illuminate plant darkspots (Ondo et al., 2024). This is challenging, as these darkspots are often countries in the Global South with rich biological and cultural diversity but severely lack resources to implement sufficient monitoring and data collection efforts. Filling this knowledge gap therefore partially requires enhancing biodiversity funding for the region, a goal aligned with the Kunming-Montreal Global Biodiversity Framework (CBD, 2022). At the same time, the rich knowledge embedded within ILK & TEK systems offers a valuable opportunity to leverage existing knowledge of utilized species, by making good use of available oral and written native language resources while strictly adhering to the principles of fair and equitable benefit sharing (CBD, 2022). These knowledge systems need to be standardized and preserved at the national level and streamlined into global data facilities, such that ILK & TEK can be used as a common pool of knowledge in favor of biodiversity, nature's contributions to society and sustainable development. Countries must recognize that ILK & TEK of utilized species is not only a crystallization of past knowledge, but also a sustainable investment opportunity for the future, including the potential to significantly expand the nation's inventory of nature's contributions to people, such as the economic development of new bioeconomy, technology, and innovation. For example, utilized plant knowledge has contributed to a 7-time increase in the export values of non-timber forest products of Vietnam in just a decade (NBCA, 2022). Existing global efforts to document and digitize knowledge on utilized species, such as the IPBES Sustainable Use Assessment and the rich body of literature it was built upon, serve as a strong foundation—one that countries can further strengthen by supporting the systematic integration and standardization of ILK & TEK deeply embedded in native language resources.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding authors.

Author contributions

TN: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. AM-S: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. GR: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. EP: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. MK: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2025.1602755/full#supplementary-material

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