Chapter 2
Ethnobotany in Mexico: History, Development, and Perspectives

Andrés Camou-Guerrero, Alejandro Casas, Ana Isabel Moreno-Calles, Jahzeel Aguilera-Lara, David Garrido-Rojas, Selene Rangel-Landa, Ignacio Torres, Edgar Pérez-Negrón, Leonor Solís, José Blancas, Susana Guillén, Fabiola Parra, and Erandi Rivera-Lozoya

Abstract Ethnobotany is defined as the study of the traditional botanical knowledge of different cultures, the techniques utilized in the use and management of plant resources, and the place they have in their cultural Cosmo vision. This study aimed to review the development and perspectives of ethnobotany in Mexico, based on an extensive review of all ethnobotanical studies showed at the Mexican Botanical Congress (MBC), the main forum of ethnobotanical studies in Mexico, between 1963 and 2010. We systematized a total of 897 works, identifying their progressive increase in the generation of investigative papers up until 1990, then a decrease until 1995 and a new increase from 1995 to the present. The main Mexican institutions studying ethnobotany are the *Universidad Nacional Autónoma de México*, *Universidad Autonóma Chapingo*, *Instituto Politécnico Nacional*, *Universidad Autónoma Metropolitana,* and the *Universidad Autónoma de Nuevo León*, which produced nearly half of all the studies recorded. The best represented cultural groups studied were the Maya, Nahua, Otomí, Totonac, and Mixtec, studied under the pre-

A. Camou-Guerrero, Ph.D. (✉) • A.I. Moreno-Calles, Ph.D.
Escuela Nacional de Estudios Superiores Unidad Morelia, Universidad Nacional Autónoma de México, Apartado Postal 27-3, Santa María de Guido, Morelia, Michoacán 58190, Mexico
e-mail: andres.camou@enesmorelia.unam.mx

A. Casas, Ph.D. • S. Rangel-Landa, M.Sc. • I. Torres, M.Sc. • E. Pérez-Negrón, L. Solís, M.Sc. • S. Guillén • F. Parra
Instituto de Investigaciones en Ecosistemas y Sustentabilidad (IIES), Universidad Nacional Autónoma de México, Campus Morelia, Michoacán, Antigua Carretera a Pátzcuaro 8711, Col. San José de la Huerta, Morelia, Michoacán C.P. 58190, Mexico

E. Rivera-Lozoya • J. Aguilera-Lara • D. Garrido-Rojas
Centro de Investigaciones en Geografía Ambiental (CIGA), Universidad Nacional Autónoma de México, Apartado Postal 27-3, Santa María de Guido, Morelia, Michoacán 58190, Mexico

J. Blancas, Ph.D.
Centro de Investigación en Biodiversidad y Conservación (CIByC), Universidad Autónoma del Estado de Morelos, Av. Universidad No. 1001, Col. Chamilpa, Cuernavaca, Morelos, C.P. 62209, Mexico

R. Lira et al. (eds.), *Ethnobotany of Mexico*, Ethnobiology,
DOI 10.1007/978-1-4614-6669-7_2

dominant approach of descriptive ethnobotany. Ethnobotany in Mexico is in a stage of growth and therefore in the phase of consolidating its approaches, particularly in the areas of ecological, economic, quantitative, and evolutionary ethnobotany. In order to achieve the development of sustainable management strategies of plant resources, it is of the highest priority to consolidate ethnobotanical research and direct it towards the analysis of environmental degradation and solutions.

Keywords Ecological ethnobotany • Economic ethnobotany • Evolutionary ethnobotany • Ethnobotanical approaches • Ethnobotanical history • Quantitative ethnobotany

Introduction

As a scientific discipline, ethnobotany emerged as a result of the co-evolution of botany and anthropology throughout the eighteenth and nineteenth centuries. It was, however, in the twentieth century when it became a consolidated study field with unique methods. Harshberger [1] first coined the term ethnobotany and defined its domain as "… the study of the interrelationships of primitive man with plants." In the 1930s, interest in economically important species introduced the term "economic botany," which made explicit the interest in linking ethnobotanical research and the prospective of new materials for industry. Oakes [2], for instance, defined economic botany as "… the link between anthropology and industry derived from plants." In contrast, for anthropologists of that time, plants and animals were elements with important cultural significance, and through the study of such significance, anthropologists constructed the early ethnobiological approaches. The anthropologist Maldonado-Köerdell [3] defined ethnobiology as "… responsible for the study of plants and animals, in any region, defined by a human group that inhabits or habituates a region to get them … essentially a cultural science." In the 1940s, ethnobiological research gained status as a discipline focused on the knowledge of plants and animals between different people. Particularly, Schultes [4] defined ethnobotany as an intermediary between botany and anthropology, whose purpose is "…the study of the relationship between humans and their plant environment…". Similarly, Jones [5] defined ethnobotany as the field of study specifically aimed at analyzing the relationship between humans and plants.

These basic concepts have prevailed in subsequent decades, but several authors have incorporated different emphases to definitions according to their perspectives. For example, Bye [6] defines ethnobotany as "… the study of the biological basis of the interactions and plant-human relationships at different levels of organization (ecosystems, communities, individuals) in a geographical, social and evolutionary scale."

Because of the momentum of the ethnobotanical movement, particularly since the 1960s and early 1970s, different research approaches in the field have been developing in Mexico to the present day. This process was reinforced by the recognition of ethnobotany as a scientific discipline, which has been strengthened with

robust methodological frameworks and depuration of the field [7–11]. By the 1970s, Latin American ethnobotany succeeded in developing a critique of the folklorist and utilitarian approaches developed mainly by some researchers from the U.S. and Europe. As part of this critique, Hernández-Xolocotzi [7] recognized the interdisciplinary nature of ethnobotany and the importance of "…the collaboration of institutes, professionals interested and trained in accordance with the inherent problems of collection, propagation and conservation." At the end of that decade, Barrera [12] defined ethnobotany as "…an interdisciplinary field that includes the study and interpretation of knowledge, cultural significance, management and traditional uses of the elements of flora"; a concept in which Hernández-Xolocotzi [13] included the dimensions of time and space "… over time and in different environments."

Currently, ethnobotany is a scientific discipline that documents, analyzes, and looks for understanding the botanical knowledge possessed by different cultural groups that inhabit the planet, the beliefs and cosmo vision in relation to the plant world around them, and interactions and practices established with plants to take advantage of their benefits. Such knowledge, beliefs, interactions, and practices are those concepts that Toledo [14] and Berkes [15] have called and defined as "corpus," "kosmos," and "praxis," respectively. These cultural elements have been the result of the development of specific human cultures in time and space and have been passed from generation to generation in oral or written form.

The main interest of this chapter is to provide a perspective about the state of ethnobotanical research in Mexico. For this task, we analyze the main approaches of ethnobotany that drive the development of this field of study in Mexico, and the perspectives, priorities, and strategies necessary to strengthen this area of research in relationship with various sectors of society.

Ethnobotanical Research, a General Overview

Numerous studies have documented traditional ethnobotanical knowledge in Mexico. These include not only utilitarian aspects of the properties of plants, but also aspects such as (a) forms and functions of their component structures, (b) life cycle, (c) behavior in relation to environmental changes (e.g., seasonality in the production of leaves, flowers, fruits, and seeds) [16–18], (d) the vulnerability or resilience to interactions with herbivores and/or competitors or to human activities (burning, logging, and other forms of disturbance) [18–22]. Traditional botanical knowledge (TBK) also includes ecological aspects like distribution and abundance of plants in specific environments, the interactions with other living beings (herbivores, frugivores, bird species that nest in them, species of insects whose larvae feed on their tissues, among others). Such knowledge can be comprehensive and is often used as criteria for classification of plant species or variants in scientific studies; see examples in [23–26], as well as for the development of management strategies [19, 21, 22, 27–30].

TBK of plants has practical application in management techniques that shape human interaction with plant populations and communities and can be classified in

different types. The first type is the extraction or harvesting of useful parts of the plants. Of the estimated 5000–7000 of plant species that are currently used by traditional people in Mexico [18], about 90 % are obtained by this kind of interaction [24]. Some ethnobotanical studies have characterized various forms of collection, including those involving community agreements to rotate and protect areas, as well as occasional vs. intensive practices [21, 22, 31, 32]. Furthermore, several studies [19, 33, 34] suggest that extractive techniques may control such factors as size, structure, and population dynamics to ensure and increase the availability of certain plant resources.

A second type of interactions between humans and plants is formed by different silvicultural forms of management. We have generally identified: (a) tolerance, which involves leaving individuals of favorable species when vegetation is purposefully disturbed, (b) promotion or encouragement of favorable species, which involves activities aimed at increasing the population density of favorable species, (c) protection, including control of herbivores, thinning of competing plants, performing pruning and other forms of protection of plants representing some utilitarian advantage for humans in natural vegetation areas subjected to deliberate disturbance, and (d) sowing and transplantation of propagules (sexual or vegetative) or complete individuals from wild environments to humans-controlled environments (such as agricultural plots, orchards, or home gardens) [19, 35–38]. In Mexico, about 700 species of plants have been documented that are subject to some of these types of silvicultural management [28]. However, this figure is likely an underestimate; for example, only in Tehuacán-Cuicatlán Valley, Blancas et al. [39] reported about 600 species under these forms of management.

Silvicultural management has been distinguished from agricultural management [19, 27]. Agriculture constitutes the third general type of interaction between humans and plants. At this level, there are great diversity of species and varieties of plants under traditional management, with a high diversity of agricultural hydraulic and intensive systems (including irrigation systems, raised or drained fields systems, and terraces systems), seasonal and semi-intensive and extensive systems (including high diversity of rain-fed systems and slash-and-burn, shifting or swidden agriculture), as well as homegardens, and agroforests combining wild and domesticated plants (e.g., cocoa, coffee, and pineapple plantations and a wide variety of types of milpa in association with elements of forests) [18, 40–42]. Traditional agriculture may involve management of varieties resulting from modern breeding processes used in intensive agricultural systems.

Mexico is one of the countries on the world with the highest biological and cultural diversities [43–45]. However, one of Mexicans' major concerns is the gradual loss of these diversities, including the threatening processes occurring on species at the community and ecosystems levels, as well as intra-specific variability at population level. These processes of loss are the result of multiple factors influencing the transformation of natural ecosystems and complex processes of causing cultural change [46], which induce the transformation of traditional management systems [42, 47, 48]. Against this backdrop, several authors have considered that for the world today, conservation and construction of sustainable management strategies of

natural resources and ecosystems are of high priority. It is also widely recognized that traditional knowledge is particularly important to these goals in the understanding, respect, use, and even improvement of local knowledge and practices to protect global patrimony [15, 47, 49]. This posture recognizes that the traditional forms of natural resource use possess traits of sustainability that must be understood and managed. It also recognizes complexity of the socio-ecological systems in which they are embedded as well as the complex processes of resource utilization that require the inclusion of human experience in the broadest sense, as well as the ongoing evaluation of successes and failures and consequent adjustments. This is the notion of adaptive management, which recognizes that the complexity of socio-ecological systems requires continuous construction, monitoring, and adjustment (adaptation) of intervention strategies of natural resources and ecosystems.

Ethnobiological studies are a window to the understanding of traditional knowledge and practices of management of biotic resources and are, therefore, crucial for technological innovation for the sustainable use of resources and environmental problems resolution. In recent decades, these goals have become increasingly explicit in ethnobiological research, particularly those research approaches that include ecological methods [26, 50–52].

Approaches to Ethnobotanical Research

Miguel Ángel Martínez-Alfaro [53], an outstanding Mexican ethnobotanist, characterized eight general lines of ethnobotanical research: (1) archaeobotany, (2) medicinal plants, (3) edible plants, (4) cognitive studies, (5) forest management, (6) agroforestry systems and orchards, (7) domestication and the origin of agriculture, and (8) historical studies. These perspectives reflect the research fields of ethnobotany, but also they are constructed from particular theoretical frameworks. In this sense, Martínez-Alfaro [53] recognizes that the research approaches referred to above are developed under various disciplines such as taxonomy, plant ecology, plant geography, plant physiology, floristic, among others. Based on the thinking of Martínez-Alfaro [53], in this study we recognize six major areas of theoretical construction of ethnobotany:

1. Descriptive ethnobotany. This approach primarily focuses on constructing listings and catalogs of plants along with their uses and traditional nomenclature.
2. Cultural ethnobotany. This perspective includes studies that analyze historical aspects of the use of plants, their cultural significance, traditional classification systems (folk classifications), linguistic analysis, processes of acculturation, and intra-cultural variation of plant use and knowledge. We also consider within this approach those studies pertaining to knowledge and traditional perception of plant resources and ecosystems, as well as studies that look for understanding the cultural significance and implications of classifications of plants and ecosystems where they occur.

3. Economic ethnobotany. This approach focuses on the economic valuation and marketing of plants (market research and exchange), the commercial and industrial potential of crops and wild plants (phytochemical analyzes, bioprospecting), processes (experimental propagation techniques of crops, among others), analyses of performance, cost–benefit balance, and studies evaluating the role of plants in peasant subsistence.
4. Ecological ethnobotany. This research perspective focuses predominantly on studies that analyze the spatial distribution, abundance, seasonal availability of plant resources, phenological studies, demographic and synecological research, as well as impact assessment for management techniques of populations of useful plants, their communities, and ecosystems. We also included studies aimed at characterizing and evaluating functional aspects of traditional management systems. In this approach, the ecological bases of the use of plant resources and the implications for conservation and sustainable management from the perspective of the ecology of populations, communities, ecosystems, and/or landscape are emphasized.
5. Evolutionary ethnobotany. This approach focuses on studies that analyze the evolutionary implications of plant management. We included researches documenting morphological variability and population genetics, physiological and reproductive variations in wild and managed plants with the goal of understanding the current processes of domestication. Archaeological, systematic, and phylogeographic studies were also included that provide understanding with regard to the evolutionary history of these processes associated with human–plant management, its origin and diffusion.
6. Theoretical ethnobotany. We included those researches that make reflection and construct theories on the ethnobotanical research as a scientific discipline. These studies generally review the development of ethnobotanical research and aspire to define and steer the course of ethnobotany. Our analysis in this chapter exemplifies this research approach.

Approaches to the State of Ethnobotanical Research in Mexico

One of the interests of the present study is to provide a perspective on the state of ethnobotanical research in Mexico. This preliminary outlook is based on the review of the abstracts of the ethnobotanical studies showed in the meetings of the Mexican Congress of Botany (MCB) from 1960 to 2010 (Table 2.1). The works presented at these congresses (including lectures, oral presentations, posters, symposia, workshops, and conferences) were considered as a primary and the most representative source of information on the ethnobotanical studies carried out in Mexico during the period referred to. It is important to clarify that the MCB is divided into thematic areas within which ethnobotany and economic botany were the primary scopes of systematization of the analyzed works. With the information obtained, we constructed a database that included: (1) the institutions at which the authors of the work presented were affiliated, (2) the locations in Mexico where the ethnobotanical

Table 2.1 Meetings of the Mexican Congress of Botany (MCB) between 1960 and 2010

MCB	Year	Date	Place
I[a]	1960	24–26 October	Ciudad de México
II	1963	17–21 September	San Luís Potosí
III	1966	24–28 October	Ciudad de México
IV	1969	8–11 September	Coahuila
V	1972	3–9 December	Ciudad de México
VI	1975	21–26 September	Veracruz
VII	1978	15–21 October	Ciudad de México
VIII	1981	17–23 October	Michoacán
IX[a]	1984	–	Ciudad de México
X	1987	27 October–03 November	Jalisco
XI	1990	30 September–5 October	Morelos
XII[a]	1992	–	Mérida
XIII	1995	5–11 November	Morelos
XIV	1998	18–24 October	Ciudad de México
XV	2001	14–19 October	Querétaro
XVI	2004	17–22 October	Oaxaca
XVII	2007	14–18 October	Zacatecas
XVIII	2010	21–27 November	Jalisco

[a]MCB meetings for which there is no information of the works presented

research was accomplished, (3) the cultural groups studied, and (4) the theoretical framework of the ethnobotanical work analyzed.

We recorded a total of 897 ethnobotanical works presented in 18 sessions of MCB between 1960 and 2010. Figure 2.1 shows a trend of progressive increase in the production of ethnobotanical works, which reach a peak in 1990 and then a drastic decrease. Such marked decline in the production of ethnobotanical works presented at the MCB was influenced by the Ejército Zapatista de Liberación Nacional uprising, which represented the starting point for the visibility and momentum of contemporary peasant and indigenous movements [54] to which ethnobotanists were particularly receptive in the academic sector. From 1995 to 2001, there was an increasing trend in the number of ethnobotanical papers presented at the MCB. Then the number of works descends again and appears to gradually recover by 2010.

A total of 116 institutions participated with ethnobotanical studies over the history of MCB, among them 70 are Mexican (66 %) and 19 are foreign (18 %) educational and research institutions, 11 government agencies (10 %), and 6 NGOs and social organizations (6 %). The ethnobotanical works reviewed in this chapter constitute a sample of the studies carried out in Mexico and mostly done by Mexican researchers and research institutions. However, Martínez-Alfaro [53] estimated that about 50 % of ethnobotanical studies in Mexico are carried out by foreigners, so this bias must be considered in the data presented here. This information indicates that

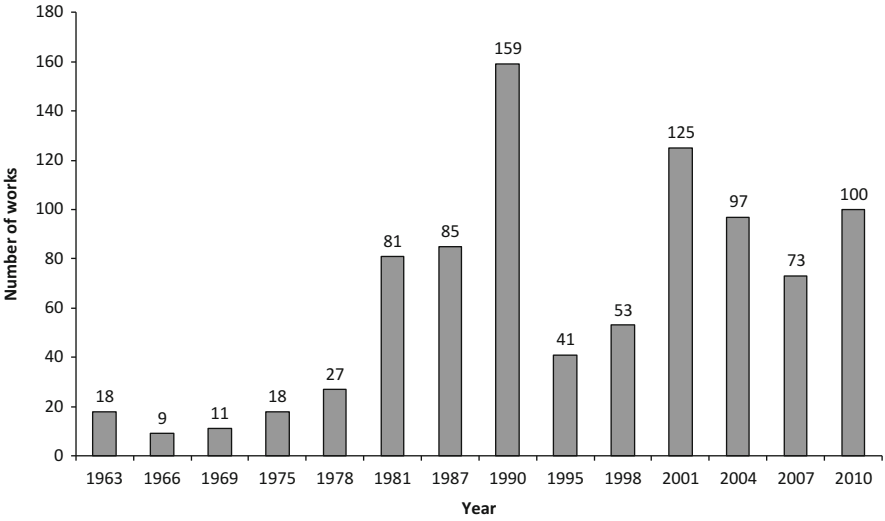

Fig. 2.1 Number of ethnobotanical works presented at the meetings of the MCB between 1963 and 2010

non-Mexican researchers and institutions developing ethnobotanical research do not regularly attend the MCB.

Among the most relevant institutions contributing with ethnobotanical works, we found the *Universidad Nacional Autónoma de México* (UNAM) with 244 studies over the period analyzed (26 %), the *Universidad Autónoma Chapingo* (UACh) with 81 (9 %), the *Instituto Politécnico Nacional* (IPN) with 63 (7 %), the *Unversidad Autónoma Metropolitana* (UAM) with 52 (6 %), and the *Universidad Autónoma de Nuevo León* (UANL) with 30 (3 %) (Fig. 2.2). About 50 % of the works presented at the MCB were produced by these five institutions located in different cities of Mexico. Other universities with significant contributions are: *Universidad Autónoma de Yucatán,* UADY (22 works), *Universidad Autónoma del Estado de Morelos*, UAEM (21 works), *Universidad de Guadalajara*, U de G (20 works), *Universidad Veracruzana*, UV (19 works), *Benemérita Universidad Autónoma de Puebla*, BUAP (17 works), *Centro de Investigación Científica de Yucatán,* CICY (15 works), and the *Universidad Autónoma del Estado de Hidalgo*, UAEH (14 works).

It appears that not all the Mexican institutions carrying out elatterthnobotanical studies are well-represented in the MCB. These are, for instance, the cases of the *Instituto Tecnológico del Valle de Oaxaca*, ITVO (with 4 works) and the *Colegio de la Frontera Sur*, ECOSUR (with 3 works), which have recognized research groups in the area of ethnobotany and ethnobiology, and are poorly represented in the MCB.

Of the 31 states that make up the Mexican nation, there has been at least one ethnobotanical study in 30 of them. The states with the highest number of studies are: Puebla (102 works), Oaxaca (70 works), Veracruz (53 works), Yucatán (43 works), Morelos (34 works), Guerrero (31 works), Tabasco (28 works), State of Mexico (26 works), and Hidalgo (26 works) (Fig. 2.3). The states that showed the lowest number of studies were: Guanajuato (2 works), Sinaloa (2 works), and

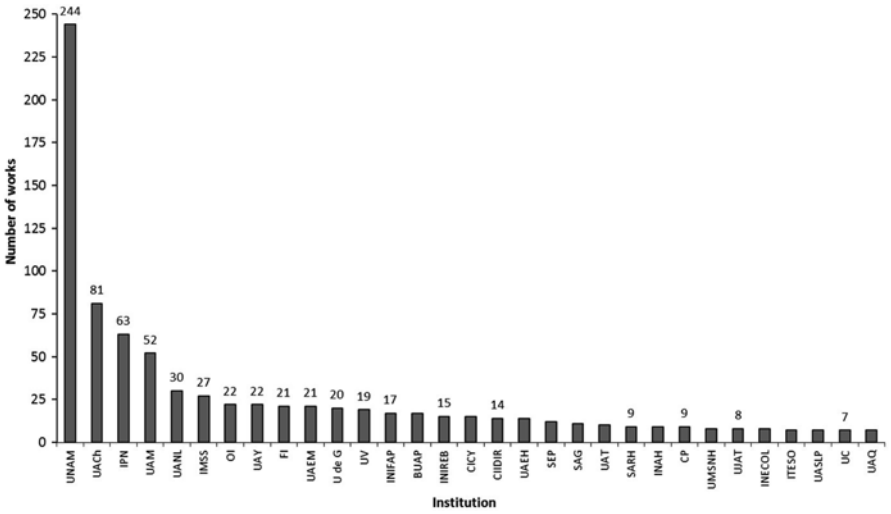

Fig. 2.2 Papers presented at the MCB (1963–2010) per institution. Universidad Nacional Autónoma de México (UNAM), Universidad Autónoma de Chapingo (UACh), Instituto Politécnico Nacional (IPN), Universidad Autónoma Metropolitana (UAM), Universidad Autónoma de Nuevo León (UANL), Instituto Mexicano del Seguro Social (IMSS), Other Institutions (OI), Universidad Autónoma de Yucatán (UAY), Foreign Institutions (FI), Universidad Autónoma del estado de Morelos (UAEM), Universidad de Guadalajara (U de G), Universidad de Veracruz (UV), Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), Benemérita Universidad Autónoma de Puebla (BUAP), (INIREB), Centro de Investigación Científica de Yucatán A.C. (CICY), Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional—IPN (CIIDIR), Universidad Autónoma del Estado de Hidalgo (UAEH), Secretaría de Educación Pública (SEP), Secretaría de Agricultura y Ganadería (SAG), Universidad Autónoma de Tamaulipas (UAT), Secretaría de Agricultura y Recursos Hidráulicos (SARH), Instituto Nacional de Antropología e Historia (INAH), Colegio de Postgraduados (CP), Universidad Michoacana de San Nicolás de Hidalgo (UMSNH), Universidad Juárez Autónoma de Tabasco (UJAT), Instituto de Ecología A.C. (INECOL), Instituto Tecnológico de Estudios Superiores de Oriente (ITESO), Universidad Autónoma de San Luis Potosí (UASLP), Universidad de Colima (UC), Universidad Autónoma de Querétaro (UAQ)

Nayarit (without any studies recorded in the MCB). This fact is important to highlight because the ethnobotanical research group of the *Facultad de Ciencias* (UNAM) has developed research projects particularly in this latter state, which is not reported in the works reviewed.

The revised works include a total of 42 indigenous cultures, including studies on the Quechua in Peru and the Kekchi in Guatemala. Indigenous cultures best represented were the Maya (39 works) (Fig. 2.4) followed by the Nahua (33 works), Mixtec (21 works), Otomí (20 works), Totonac (18 works), and the Zapotec (12 works). Indigenous cultures underrepresented (only one registered study each) are the Chol, Huichol, Ixcatec, Matlatzinca Mayo, Pima, Seri, Tlapanec, Tlaxcaltec, Tzeltal, and Yaqui. Nearly 74 % of the abstracts made no reference to any indigenous cultures in particular, which is apparently because the studies were conducted with Mestizo people.

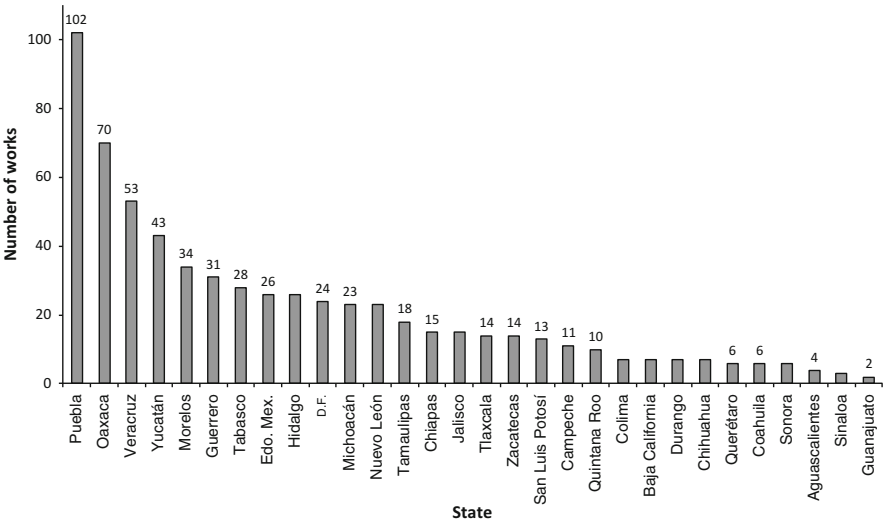

Fig. 2.3 Ethnobotanical works presented in the MCB (1963–2010) by state

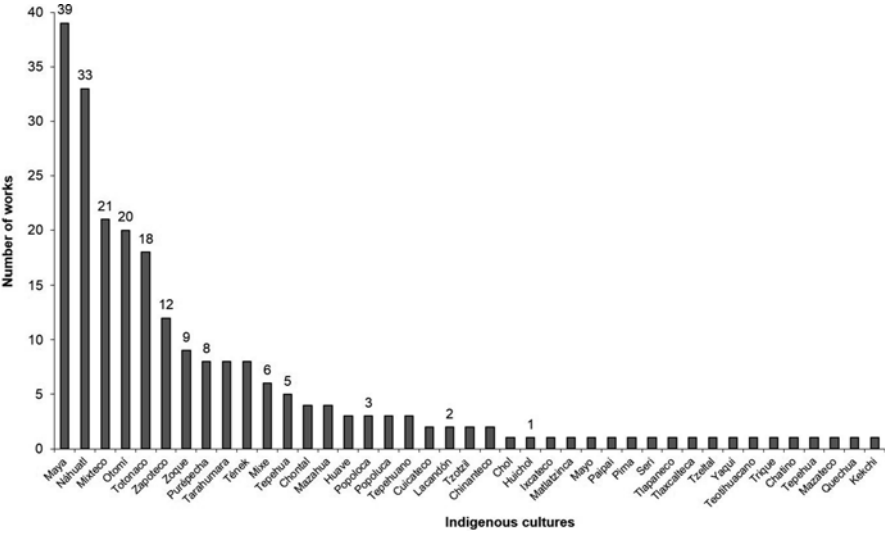

Fig. 2.4 Papers presented at meetings of the MCB (1963–2010) by indigenous cultures

Table 2.2 shows the total number of studies recorded in the Ethnoecological Atlas database [46, 55] relative to those recorded in the MCB and takes into account the most represented original cultures. Although the Ethnoecological Atlas includes information from different fields of knowledge (not just from the ethnobotanical perspective), the Maya, Nahua, Mixtec, Totonac, and Otomí are also the best represented, which is consistent with findings in our MCB sample. To date, there have been studies on 40 of the 68 indigenous groups [56], and 56 % of the total have

Table 2.2 Works reported in the Ethnoecological Atlas vs. the ethnobotanical works presented in the MCB between 1963 and 2010

Cultural group	Ethnoecological atlas[a]	MCB
1. Maya	596	39
2. Nahua	238	33
3. Purépecha (P´urhépecha)	151	8
4. Zapoteco (Ben´zaa o binnizá o bene xon)	129	12
5. Chontal (Oaxaca y Tabasco)	102	4
6. Tzotzil (Batzil K´op)	100	2
7. Mixteco (Ñuu Savi)	96	21
8. Totonaca (Tachihuiin)	85	18
9. Otomí (Ñahñú o hñä hñü)	71	20
10. Tarahumara (Rarámuri)	71	8

[a]Toledo et al. (2001)

focused on only five of them. From the perspective of the two sources of information, the need for more ethnobotanical studies including a greater number of the Mexican original groups is clear.

In the 1960s, the studies focused on economic ethnobotany and ecological ethnobotany approaches dominated the ethnobotanical research in Mexico. Only these two approaches covered 28.6 % (6 works) and 47.6 % (10 works), respectively, of the papers presented in the 1963 MCB (Table 2.3). In that decade, the studies covering descriptive ethnobotanical approaches, cultural ethnobotany, evolutionary ethnobotany, and theoretical ethnobotany were scarce (Table 2.3). However, from the 1970s, there has been a gradual increase in the number of ethnobotanical work using the different approaches considered in this analysis. The proportion of research with a descriptive approach went up in the late 1970s becoming the predominant approach at the MCB (29 papers on average per conference) followed by economic ethnobotany (18 papers), cultural ethnobotany (17 papers), ecological ethnobotany (16 papers), evolutionary ethnobotany (3 papers), and theoretical ethnobotany (3 papers on average per conference) (Table 2.3). It is noteworthy that, since 1990, there has been a trend toward presenting a more even proportion of the papers pertinent to the different ethnobotany research approaches at MCB conferences.

The scope of the analysis presented here represents only a sample of the ethnobotanical production in Mexico mainly by Mexicans and not all the research generated either by national or foreign educational and research institutions. Moreover, understanding the interests and motivations of the ethnobotanical research in Mexico is incomplete from the characterization of the theoretical approaches that we have made. We recognize that a limitation of our analysis is the review of only the abstracts of works presented at the MCB (which is the information available in the reports of the congresses that were reviewed) and also that we identified that other research areas developing etnobotanical studies (for instance, anthropologists) are not well-represented in the MCB. Therefore, to have a more complete picture of the development of ethnobotany in Mexico is necessary to expand the sources of analysis (including theses, scientific articles, books, interviews, among others). However, the trends and proportions identified based on this source allow

Table 2.3 Number of papers presented at the MCB between 1963 and 2010 by each ethnobotanical research approach

Year	Descriptive	Cultural	Economic	Ecological	Evolutionary	Theoretical
1963	3 (14.3)	1 (4.8)	6 (28.6)	10 (47.6)	0	1 (4.8)
1966	2 (22.2)	0	6 (66.7)	1 (11.1)	0	0
1969	2 (18.2)	0	2 (18.2)	5 (45.5)	2 (18.2)	0
1975	6 (28.6)	0	6 (28.6)	4 (19.0)	2 (9.5)	3 (14.3)
1978	14 (40.0)	4 (11.4)	8 (22.9)	5 (14.3)	1 (2.9)	3 (8.6)
1981	30 (27.0)	21 (18.9)	20 (18.0)	35 (31.5)	1 (0.9)	4 (3.6)
1987	48 (39.7)	24 (19.8)	32 (26.4)	16 (13.2)	0	1 (0.8)
1990	78 (35.8)	46 (21.1)	41 (18.8)	33 (15.1)	12 (5.5)	8 (3.7)
1995	16 (32.0)	11 (22.0)	11 (22.0)	7 (14.0)	2 (4.0)	3 (6.0)
1998	24 (32.9)	12 (16.4)	16 (21.9)	18 (24.7)	3 (4.1)	0
2001	35 (35.0)	23 (23.0)	18 (18.0)	17 (17.0)	5 (5.0)	2 (2.0)
2004	38 (31.9)	24 (20.2)	33 (27.7)	17 (14.3)	6 (5.0)	1 (0.8)
2007	50 (39.4)	27 (21.3)	17 (13.4)	30 (23.6)	3 (2.4)	0
2010	55 (34.8)	44 (27.8)	31 (19.6)	22 (13.9)	4 (2.5)	2 (1.3)
Annual average	29	17	18	16	3	2

The number in parentheses represents the ratio of works per year

identifying the heterogeneity of the development of the research approaches and those cultural groups and ecological regions that need to be studied.

Ethnobotanical Research Perspectives in Mexico

Ethnobotany currently faces challenges that lie beyond the scientific activity and encourages reflection on the academic work of ethnobotanists. In the twenty-first century, ethnobotany has a wide range of applications and roles in society that easily exceed the scientist work. It has a strategic position in the search for solutions to environmental problems and faces philosophical, ethical, epistemological challenges in local and global challenging contexts [53, 57]. As in the context of other disciplines, and particularly ethnosciences [58, 59], there are three useful paradigms that can guide the ethnobotanical research.

Sustainability Science

At a first level, seeking sustainable management of natural resources elucidates the need to develop models that: (1) maintain and restore the natural resources and ecosystem processes, (2) strengthen the social organization of the sectors that interact with ecosystems and resources, and (3) generate more equitable economic

processes [60–62]. In the scientific literature, there are numerous references to the great difficulties in operationalizing the concept of sustainability. Among other limiting factors, the specialization and reductionist methods that dominate contemporary scientific research can be mentioned [63, 64]. Due to the complexity of common epistemic frameworks articulated under different fields of knowledge, another of the great challenges is to include the participation of different stakeholders in addressing socio-ecological problems, as well as the attention to the various scales at which they occur [63–66].

Several authors have raised the need to develop a sustainability science [67] whose essential features are recognized to be: (a) that the problems associated with natural resource management must be viewed from a systemic point of view, both from a social and ecological perspective, as these form all socio-ecological systems, (b) the design of interventions in these systems requires interdisciplinary interaction and the participation of different social sectors, (c) such approaches must consider operating processes in trans-scalar systems, and (d) the complexity of the systems and the high level of uncertainty that exists requires the adoption of interim intervention schemes subject to ongoing assessments of experiences and effects (adaptive management).

In the context of sustainability science, ethnobotany has much to contribute. The information documented through the research approaches considered in this study are of great relevance in making decisions about harvesting resources and techniques as well as the socio-economic and ecological implications of such use. Ethnobotany also has a close relationship with community development processes among its many purposes; an important one is analyzing the different dimensions of production in terms of natural, economic, and socio-cultural implications and significance [68, 69].

Participatory Research and the Dialogue of the Different Forms of Knowledge

Ethnobotany encourages the process of community participation in the management and administration of natural resources. One of the major obstacles in solving environmental problems is the lack of participation [70, 71]. Through participatory processes, it is feasible to generate horizontal and reciprocal relationships within the community and external agents to strengthen the social fabric and decision-making related to the use and enjoyment of natural resources [72]. Today, there are many participatory approaches seeking sustainability with regard to the exploitation of natural resources [73, 74] and they are useful for visualizing the cross-interaction networks that must be woven together to successfully achieve the project objectives.

Conventionally, transfering of information and technology arising from research institutions has been unidirectional and flowed top-down [75]. This process has led to confrontations in at least two different knowledge structures putting peasant knowledge in opposition to technical–scientific Western perceptions [76]. This has often resulted in significant cultural transformation [77–79].

While ethnobotany may significantly contribute to sustainable management processes of resources and ecosystems, as well as reassessing and documenting local management practices, encouraging ownership of "technology" in a particular cultural context implies that it must be related to topics of interest to the community [72]. This approach represents reverse knowledge transfer from a community to other areas (e.g., Academic sectors), with respect for local ideas, arguments, and innovative capabilities as a means to strengthen the processes of organization and community development [80]. In this sense, the dialogue of knowledge paradigm [81, 82] is an approach that is useful for interchange between different social sectors such as no governmental organizations, rural, periurban and urban stakeholders, governmental institutions, and academic sectors. Ethnobotany can and should adopt such paradigm and promote research around wisdom, knowledge, and values in the relationship between plants and human beings with cultural, economic, ecological, political, and social differences.

Cultural transformation affects not only the technological aspects of the appropriation of nature, it also generates changes in social structure, habits, and consumption patterns of land use and resources, which can generate gradual differences between the needs of young and old, between migrants and residents, among original groups and mestizos, etc. [83]. Accordingly, ethnobotany can play an important role in building communication bridges between sectors of a community helping to maintain balanced information exchange and preserve cultural values in rural communities.

Intellectual Property Rights, Bioprospecting, and Biopiracy

Today, intellectual property rights relating to natural resources is a topic of much debate worldwide. It is sparked by conflicts between rural communities generating knowledge, skills, and proprietary of genetic resources on the one hand, and large companies that make use of such resources and knowledge for private profits on the other [84]. The topic is certainly of great importance in the context of respect for cultures, equity, and human rights.

The exploration of biodiversity in search of genetic and biochemical resources with commercial value (bioprospecting) based on traditional knowledge brings with it the issue of biopiracy. Pat Mooney defined the term in 1993 [85] and described it as "…the use of intellectual property to legitimize the exclusive right and control of knowledge and biological resources without recognition, reward or protection of the contributions of indigenous peoples." Biologists and ecologists in general have been signaled from members of academic and non-academic sectors, as voluntary or involuntary partners in the process of bioprospecting, and worse as collaborators in biopiracy. Therefore, there is a social and political demand that ethnobiologists should participate actively in creating alternatives to protect and preserve the rights of the indigenous people on their traditional knowledge and their genetic resources.

According to Toledo [55], in Mexico, there are numerous examples of natural resource management within what he calls "the silent revolution." This movement

included nearly 15 years ago more than 2000 cases of ejidos and communities, associations, and cooperatives in over 12 states of Mexico. It is possible to state that this number has significantly increased during the last years because of the social resistance movements including demands in relation to natural resources, property rights of genetic resources, and biosafety. This movement engaged processes like: (1) agroecological and organic products, (2) sustainable forest management, (3) non-timber forest resource extraction, (4) defense of territory and natural resources, and (5) ecotourism projects. Anta and Pérez-Delgado [86, 87] and Toledo et al. [88] documented more than 800 community events in the sustainable management of natural resources in the states of Michoacán, Oaxaca, and Quintana Roo alone. It is precisely in the context of these civil society movements aimed at sustainable management of natural resources, in which ethnobotany's relevance is most pertinent and currently most needed. Its active role in the generation of information to answer questions about the *kosmos*, *corpus,* and *praxis* related to the plant world is of great value to support the processes of technological innovation, social organizational and institutional linkages that can guide local strategies, and policies with the goal of achieving locally and globally sustainability and equity. As well as helping to identify those whose knowledge should be recognized and the knwoledge that should be recognized.

Conclusions

According to the information analyzed, ethnobotany in Mexico experienced a diversification of approaches, a decreasing trend in the 1990s with a recovering during the last decade (2010). The number of studies recorded increased and decreased in different areas, suggesting that Mexican ethnobotany is still dynamically evolving. The information suggests that Mexican ethnobotany emerged closely related to ecological, economic botany, and floristic studies. The predominant approach has been descriptive ethnobotany, focused on a limited number of research institutions, regions, and people. One of the challenges facing this field of research in Mexico is therefore to direct their growth seeking to strengthen the diversity of approaches and research groups, particularly more analytical-focused approaches as well as strengthening research groups especially in institutions that are outside of Mexico City.

Ethnobotany is an area of research that addresses questions regarding *kosmos*, *corpus*, and *praxis* in relation to plants. It combines anthropological, botanical, ecological, and evolutionary approaches, among others. However, it is infrequent that specialists of different disciplines converge, being more common for specialists to penetrate into domains beyond their specialty areas to address their ethnobotanical questions. This condition suggests that ethnobotany is still facing the challenge of developing interdisciplinary interaction mechanisms and further transdisciplinary research approach. The latter are particularly relevant in a research field in which knowledge of cultural groups is the main focus. The development of disciplinary, interdisciplinary, and transdisciplinary approaches is very important to address the issue of strategies for the sustainable use of natural resources and ecosystems.

Acknowledgments We would like to thank the Posgrado en Ciencias Biológicas, UNAM and the Escuela Nacional de Estudios Superiores Unidad Morelia, UNAM. Also, we would like to thank the Project Support Programme for Research and Technological Innovation (PAPIIT) (project IN209214, IN205111-3 and IA 203213-2) and Consejo Nacional de Ciencia y Tecnología (CONACYT) (CB-2008-01-103551, CB-2013-01-221800) for providing funding.

References

1. Harshberger JW. The purpose of ethno-botany. Bot Gaz. 1896;21:46–154.
2. Oakes A. Economic annuals and human cultures. Cambridge: Botanical Museum of Harvard University; 1939.
3. Maldonado-Köerdell M. Estudios etnobiológicos I. Definición, relaciones y métodos de la etnobiología. Revista Mexicana de Estudios Antropológicos. 1940;4:195–202.
4. Schultes RE. La etnobotánica: sus alcances y objetivos. Caldasia. 1941;3:7–12.
5. Jones VH. The nature and status of etnobotany. Chron Bot. 1941;6:219–21.
6. Bye RA. Ethnobotany of the Mexican tropical dry forest. In: Bullock S, Mooney H, Medina E, editors. Seasonally dry tropical forest. New York: Cambridge University Press; 1995.
7. Hernández-Xolocotzi E. Apuntes sobre la Exploración Etnobotánica y su Metodología. Chapingo: Colegio de Posgraduados; 1971.
8. Bye RA. Voucher specimens in ethnobiological studies and publications. J Ethnobiol. 1986;6:1–8.
9. Martin G. Ethnobotany. A methods manual. London: Chapman & Hall; 1995.
10. Alexiades M. Collecting ethnobotanical data: an introduction to basic concepts and techniques. In: Alexiades M, Sheldon JW, editors. Selected guidelines for ethnobotanical research: a field manual. Bronx: New York Botanical Garden; 1996.
11. Cotton CM. Ethnobotany. Principles and applications. New York: Wiley; 1997.
12. Barrera A. La etnobotánica. In: Barrera A, editor. La Etnobotánica: Tres Puntos de Vista y una Perspectiva. Xalapa: Instituto de Investigaciones Sobre Recursos Bióticos, A.C.; 1979.
13. Hernández-Xolocotzi E. In: Barrera A, editor. La Etnobotánica: Tres Puntos de Vista y una Perspectiva. Xalapa: Instituto de Investigaciones Sobre Recursos Bióticos, A.C.; 1979.
14. Toledo VM. What is ethnoecology? Origins, scope and implications of a rising discipline. Etnoecológica. 1992;1:5–23.
15. Berkes F, Colding J, Folke C. Rediscovery of traditional ecological knowledge as adaptive management. Ecol Appl. 2000;10:1251–62.
16. Zizumbo-Villarreal D, Colunga P. Los Huaves: la Apropiación de los Recursos Naturales. Chapingo: Universidad Autónoma de Chapingo; 1982.
17. Alcorn J. El *Te 'lom* huasteco: Presente, pasado y futuro de un sistema de silvicultura indígena. Biótica. 1983;8:315–31.
18. Casas A, Viveros JL, Caballero J. Etnobotánica Mixteca: Sociedad, Cultura y Recursos Naturales en la Montaña de Guerrero. México: INI/CONACULTA; 1994.
19. Casas A, Pickersgill B, Caballero J, Valiente-Banuet A. Ethnobotany and domestication in Xoconochtli, Stenocereus stellatus (Cactaceae) in the Tehuacan Valley and La Mixteca Baja, México. Econ Bot. 1997;51(3):279–92.
20. Casas A, Caballero J, Mapes C, Zárate S. Manejo de la vegetación, domesticación de plantas y origen de la agricultura en Mesoamérica. Boletín de la Sociedad Botánica de México. 1998;61:30–47.
21. White PS, Collins B, Wiens G. Natural disturbances and early successional habitats. In: Greenberg CH, Collins BS, Thompson FR, editors. Managing forest ecosystems: sustaining young forest communities, vol. 21. New York: Springer; 2011.
22. Wilfahrt PA, Collins B, White PS. Shifts in functional traits among tree communities across succession in eastern deciduous forest. For Ecol Manage. 2014;324:179–85.
23. Berlin B, Breedlove DE, Raven P. Principles of Tzeltal plant classification: an introduction to the botanical ethnography of a Mayan-speaking community in Highland Chiapas. New York: Academic; 1974.

24. Casas A, Caballero J. Traditional management and morphological variation in Leucaena esculenta (Moc. et Sessé ex A.DC.) Benth., in the Mixtec region of Guerrero, Mexico. Econ Bot. 1996;50:167–81.
25. Knight et al. No está en las referencias; 1998.
26. Farfán B, Casas A, Ibarra G, Pérez-Negrón E. Mazahua ethnobotany and people subsistence in the Monarch Butterfly Biosphere Reserve, Mexico. Econ Bot. 2007;61:173–91.
27. Casas A, Vázquez MC, Viveros JL, Caballero J. Plant management among the Nahua and the Mixtec of the Balsas River Casin: an ethnobotanical approach to the study of plant domestication. Hum Ecol. 1996;24:455–78.
28. Casas A, Parra F. Agrobiodiversidad, parientes silvestres y cultura. LEISA Revista de Agroecología. 2007;23:5–8.
29. Parra F, Casas A, Peñaloza-Ramírez JM, Cortés-Palomec AC, Rocha-Ramírez V, González-Rodríguez A. Evolution under domestication: ongoing artificial selection and divergence of wild and managed Stenocereus pruinosus (Cactaceae) populations in the Tehuacán Valley, Mexico. Ann Bot. 2010;106:483–96.
30. Aguirre-Dugua X, Eguiarte LE, González-Rodríguez A, Casas A. Round and large: morphological and genetic consequences of artificial selection on the gourd tree Crescentia cujete by the Maya of the Yucatan Peninsula, Mexico. Ann Bot. 2012;109:1297–306.
31. González-Insuasti MS, Caballero J. Managing plant resources: how intensive can it be? Hum Ecol. 2007;35:303–14.
32. González-Insuasti MS, Casas A, Méndez-Ramírez I, Martorell C, Caballero J. Intra-cultural differences in the importance of plant resources and their impact on management intensification in the Tehuacán Valley, Mexico. Hum Ecol. 2011;39:191–202.
33. Rhoads JW. Through a glass darkly: present and past of Papuan Sago Palm users. PhD thesis, Research School of Pacific Studies, Australian National University, Canberra; 1980.
34. Groube L. The taming of the rainforest: a model for late Pleistocene forest exploitation in New Guinea. In: Harris DR, Hillman GC, editors. Foraging and farming. The evolution of plant exploitation. London: Unwin Hyman; 1989. p. 292–304.
35. Harlan JR. Crop and Man. Wisconsin: American Society Agronomic de Madison; 1975.
36. Bye RA. The role of humans in the diversification of plants in Mexico. In: Ramamoorthy TP, Bye RA, Lot A, Fa JE, editors. Biological diversity of Mexico: origins and distribution. Oxford: Oxford University Press; 1993.
37. Caballero J, Casas A, Cortés L, Mapes C. Patrones en el conocimiento, uso y manejo de plantas en pueblos indígenas de México. Estudios Atacameños. 1998;16:181–96.
38. Casas A, Otero-Arnaiz A, Pérez-Negrón E, Valiente-Banuet A. In situ management and domestication of plants in Mesoamerica. Ann Bot. 2007;100:1101–15.
39. Blancas J, Casas A, Rangel-Landa S, Moreno-Calles A, Torres I, Pérez-Negrón E, Solís L, Delgado-Lemus A, Parra F, Arellanes Y, Caballero J, Cortés L, Lira R, Dávila P. Plant management in the Tehuacán-Cuicatlán Valley, Mexico. Econ Bot. 2010;64:287–302.
40. Rojas-Rabiela T. Agricultura prehispánica. In: Rojas-Rabiela T, editor. La Agricultura en Tierras Mexicanas Desde sus Orígenes Hasta Nuestros Días. México: Comisión Nacional para la Cultura y las Artes/Grijalbo S.A. de C.V.; 1991.
41. Toledo VM. Saberes indígenas y modernización en América Latina: historia de una ignominia tropical. Etnoecológica. 1996;3:135–47.
42. Moreno-Calles AI, Toledo VM, Casas A. Los sistemas agroforestales tradicionales de México: Una aproximación biocultural. Bot Sci. 2013;91(4):375–98.
43. Toledo VM, Ordoñez MJ. The biodiversity scenario of Mexico: a review of terrestrial habitats. In: Ramamoorthy TP, Bye RA, Lot A, Fa JE, editors. Biological diversity of Mexico: origins and distribution. Oxford: Oxford University Press; 1993.
44. Mittermeier RA, Robles P, Goettsch C. Megadiversidad. Los Países Biológicamente más Ricos del Mundo. Montreal: Quebecor; 1997.
45. Sarukhán J, Kolef P, Carabias J, Soberón J, Dirzo R, Llorente-Bousquets J, Halffter G, González R, March I, Mohar A, Anta S, De la Maza J. Capital Natural de México. Síntesis: conocimiento actual, evaluación y perspectivas de sustentabilidad. México: CONABIO; 2009.

46. Toledo VM. Biodiversity and indigenous peoples. In: Levin S, editor. Encyclopedia of biodiversity. New York: Academic; 2001.
47. Moreno-Calles AI, Casas A, Blancas J, Torres I, Masera O, Caballero J, García-Barrios L, Pérez-Negrón E, Rangel-Landa S. Agroforestry systems and biodiversity conservation in arid zones: the case of the Tehuacan Valley, Central Mexico. Agrofor Syst. 2010;80:315–31.
48. Moreno-Calles AI, Casas A, García-Frapolli E, Torres-García I. Traditional agroforestry systems of multi-crop "milpa" and "chichipera" cactus forest in the arid Tehuacan Valley Mexico: their management and role in people's subsistence. Agrofor Syst. 2012;84:207–26.
49. Hecht SB, Posey DA. Preliminary results of soil management techniques of the Kayap Indians. Adv Econ Bot. 1989;7:174–88.
50. Martínez-Ballesté A, Martorell C, Martínez-Ramos M, Caballero J. Applying retrospective demographic models to assess sustainable use: the Maya management of Xa'an palms. Ecol Soc. 2005;10:17.
51. Pulido MT, Valverde T, Caballero J. Variation in the population dynamics of the palm Sabal yapa in a landscape shaped shifting cultivation in the Yucatán Peninsula, Mexico. J Trop Ecol. 2007;23:139–49.
52. Pérez-Negrón E, Casas A. Use, extraction rates and spatial availability of plant resources in the Tehuacán–Cuicatlán Valley, Mexico: The case of Quiotepec, Oaxaca. J Arid Environ. 2007;70:356–79.
53. Martínez-Alfaro MA. Estado actual de las investigaciones etnobotánicas en México. Boletín de la Sociedad Botánica de México. 1994;55:65–74.
54. Toledo VM. La Paz en Chiapas. Ecología, Luchas Indígenas y Modernidad Alternativa. México: Instituto de Biología, UNAM; 2000.
55. Toledo et al. No está en las referencias; 2013.
56. Instituto Nacional de Lenguas Indígenas (INALI). Catálogo de las lenguas indígenas nacionales: variantes lingüísticas de México con sus autodenominaciones y referencias geoestadísticas. México: Diario Oficial; 2008.
57. Alexiades M. Ethnobotany in the third millennium: expectations and unresolved issues. Delpinoa. 2003;45:15–28.
58. Toledo VM, Alarcón-Cháires P. La etnoecología hoy: panorama, avances, desafíos. Etnoecológica. 2012;20:1–16.
59. Hunn E. Ethnobiology in four phases. J Ethnobiol. 2007;27(1):1–10.
60. Lélé SM. A framework for sustainability and its application in visualizing a peaceful and sustainable society. Berkeley: University of California; 1991.
61. Lélé SM. Sustainability: a plural, multi-dimensional approach. Berkeley: University of California; 1993.
62. Goodland R. The concept of environmental sustainability. Annu Rev Ecol Syst. 1995;26:1–24.
63. Holling CS. Understanding the complexity of economic, ecological, and social systems. Ecosystems. 2001;4:390–405.
64. Ludwig D. The era of management is over. Ecosystems. 2001;4:758–64.
65. Funtowicz S, Ravetz JR, O'Connor M. Challenges in the use of science for sustainable development. Int J Sustain Dev. 1998;1:99–107.
66. Toledo VM, Castillo A. La ecología en Latinoamérica: siete tesis para una ciencia pertinente en una región en crisis. Interciencia. 1999;24:157–67.
67. Kates W, Clark WC, Corell R, Hall JM, Jaeger CC, Lowe I, McCarthy JJ, Schellnhuber HJ, Bolin B, Dickson NM, Faucheux S, Gallopin GC, Grübler A, Huntley B, Jäger J, Jodha NS, Kasperson RE, Mabogunje A, Matson P, Mooney H, Moore B, O'Riordan T, Svedin U. Sustainability science. Science. 2002;292:641–2.
68. Toledo VM, Barrera-Bassols N. Ecología y Desarrollo Rural en Pátzcuaro: Un Modelo para el Análisis Interdisciplinario de Comunidades Campesinas. México, DF: Instituto de Biología UNAM; 1984.
69. Toledo VM, Barrera-Bassols N. La Memoria Biocultural. La Importancia Ecológica de las Sabidurías Tradicionales. Barcelona: Icaria Editorial; 2008.

70. Abbot J, Gujit I. Changing views on change: participatory approaches to monitoring the environment. London: International Institute for Environment and Development; 1998.
71. Alemán-Santillán T. Investigación Participativa para el Desarrollo Rural. La experiencia de Ecosur en Los Altos de Chiapas. San Cristóbal de las Casas: Fundación Rockefeller; 1998.
72. Guerrero MT, López S. Guía Metodológica para la Educación de Adultos. Un Sistema de Educación no Formal para el Manejo de Recursos Naturales. Chihuahua: COSYDDHAC–CONTEC; 2000.
73. Bocco G, Velásquez A, Torres A. Ciencia, comunidades indígenas y manejo de recursos naturales. Un caso de investigación participativa en México. Interciencia. 2000;25:64–70.
74. Segura GW, García-Peña E. Desarrollo forestal comunitario. El caso del proyecto de conservación y manejo sustentable de recursos forestales en México (PROCYMAF). In: Rendón B, Rebollar S, Caballero J, Martínez MA, editors. Plantas, Cultura y Sociedad. México, DF: Universidad Autónoma Metropolitana/SEMARNAP; 2001.
75. Castillo A. Ecological information system: analyzing the communication and utilization of scientific information in Mexico. Environ Manage. 2000;25:383–92.
76. Agrawal A. Indigenous and scientific knowledge: some critical comments. IK Monitor. 2004;3:1–9.
77. Lara SM. Nuevas Experiencias Productivas y Nuevas Formas de Organización Flexible del Trabajo en la Agricultura Mexicana. México, DF: Juan Pablos Editor/Procuraduría Agraria; 1998.
78. Guerrero MT, Reed C, Vegter B. La Industria Forestal y los Recursos Naturales en la Sierra Madre de Chihuahua: Impactos Sociales, Económicos y Ecológicos. Chihuahua: Comisión de Solidaridad y Defensa de los Derechos Humanos, A.C. (COSIDDHAC)/Texas Center for Policy Studies; 2000.
79. Toledo VM, Alarcón-Chaires P, Barón L. Revisualizar lo rural: un enfoque socioecológico. Gaceta Ecológica. 2002;62:7–20.
80. Thrupp LA. La legitimación del conocimiento local: de la marginación al fortalecimiento de los pueblos del tercer mundo. In: Leff E, Carabias J, editors. Cultura y Manejo Sustentable de los Recursos Naturales. México, DF: Centro de Investigaciones Interdisciplinarias en Humanidades UNAM/Grupo Editorial Porrúa; 1993.
81. Argueta A. El diálogo de saberes, una utopía realista. In: Argueta A, Corona M, Hersch P, editors. Saberes colectivos y dialogo de saberes en México. Proyecto "Compartiendo saberes." Puebla: CRIM-UNAM, UNAH, UIA, Foncicyt; 2011.
82. Leff E. Diálogo de saberes, saberes locales y racionalidad ambiental en la construcción de social de la sustentabilidad. In: Argueta A, Corona M, Hersch P, editors. Saberes colectivos y dialogo de saberes en México. Proyecto "Compartiendo saberes." Puebla: CRIM-UNAM, UNAH, UIA, Foncicyt; 2011.
83. García-Barrios L, García-Barrios R. La modernización de la pobreza: dinámicas de cambio técnico entre los campesinos temporaleros de México. Estudios Sociológicos. 1992;29:263–405.
84. Banda O. Protección de Recursos Fitogenéticos o legalización del saqueo. Comentarios a la "iniciativa de ley de conservación y aprovechamiento sustentable de los recursos fitogenéticos para la alimentación y la agricultura". [Internet]. 2008. [cited 2014 Jul 10]. Available from: http://prdleg.diputados.gob.mx/debate_parlamentario/Debate_parlamentario_mayo_junio_2008/p_social_03.html.
85. Delgado G. La biopiratería y la propiedad intelectual como fundamento del desarrollo biotecnológico. Problemas del desarrollo. 2001;32:175–209.
86. Anta S, Pérez-Delgado P. Atlas de Experiencias Comunitarias en Manejo Sostenible de los Recursos Naturales en Oaxaca. México, DF: SEMARNAT; 2004.
87. Anta S, Pérez-Delgado P. Experiencias Comunitarias en el Buen Manejo de los Recursos Naturales en el Estado de Quintana Roo. México, DF: UCPAST-SEMARNAT; 2005.
88. Toledo VM, Alarcón-Cháirez P, Ortiz-Avila T, Acosta-Moreno L. Atlas de experiencias comunitarias en el manejo sustentable de los recursos naturales de Michoacán. México, DF: SEMARNAT; 2006.