PROPOSAL FOR THE RECOGNITION OF

ICH KOOL: MAYAN MILPA OF THE YUCATAN PENINSULA, MEXICO.

AS A GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEM

March 2023


Food and Agriculture
Organization of the
United Nations


Globally Important
AGRICULTURAL
HERITAGE
Systems

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CORN STALKS. PHOTO: THE NATURE CONSERVANCY

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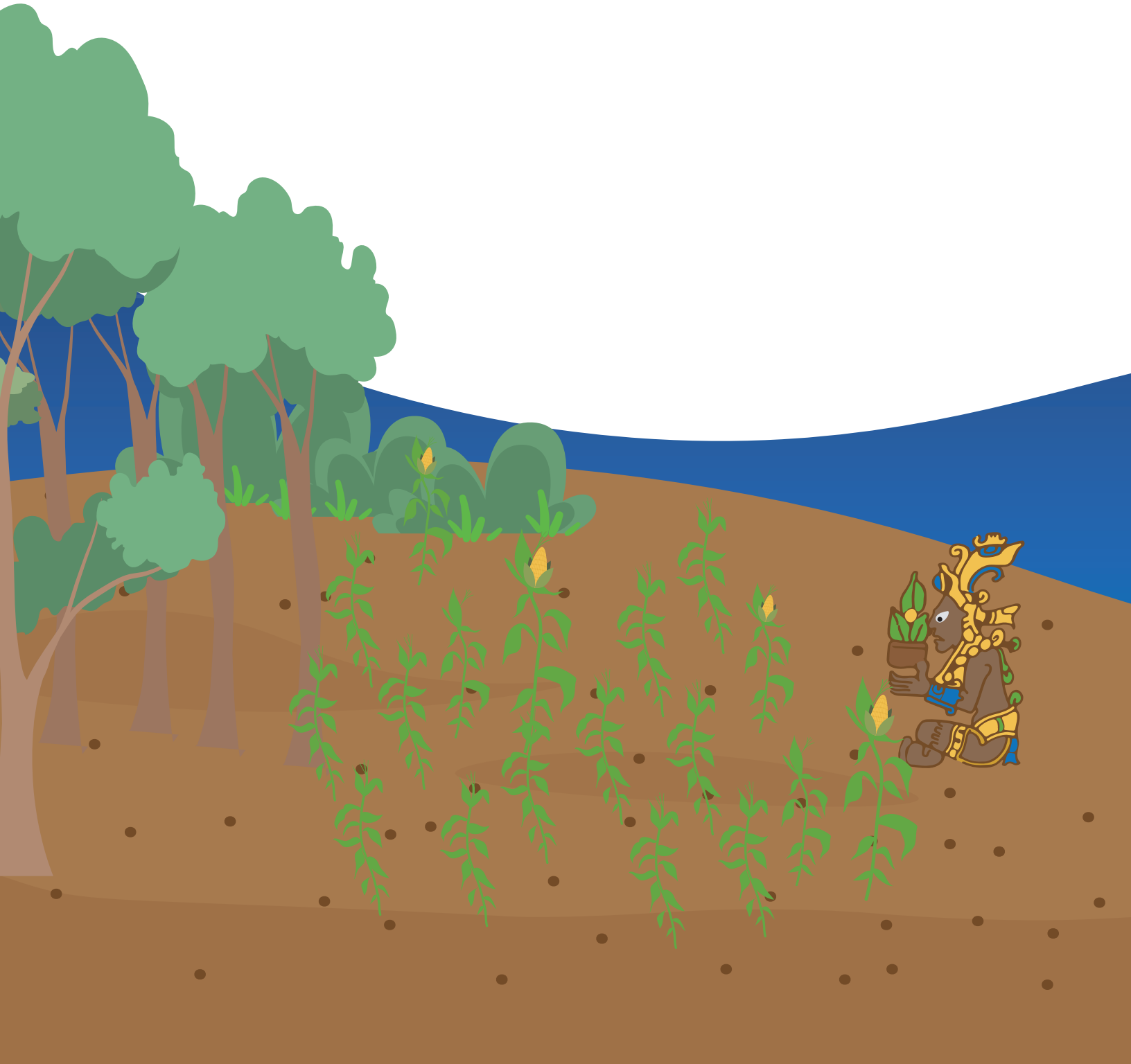
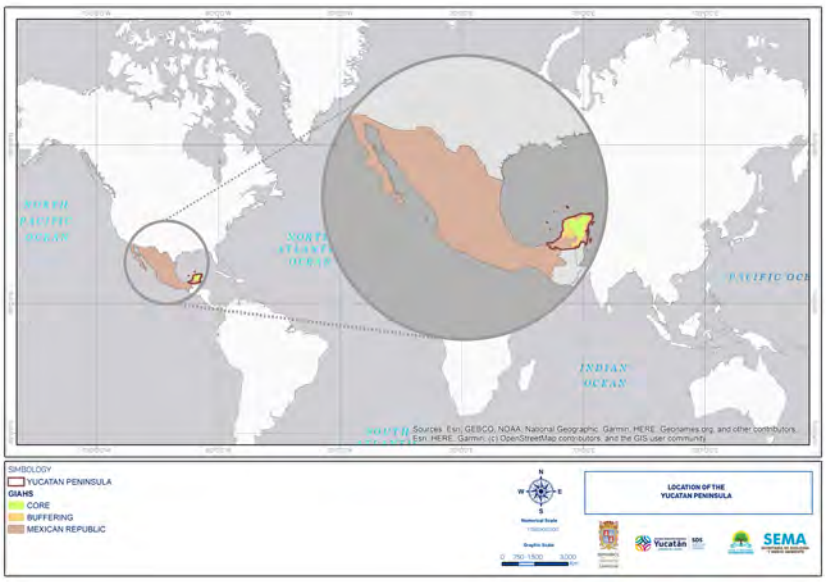
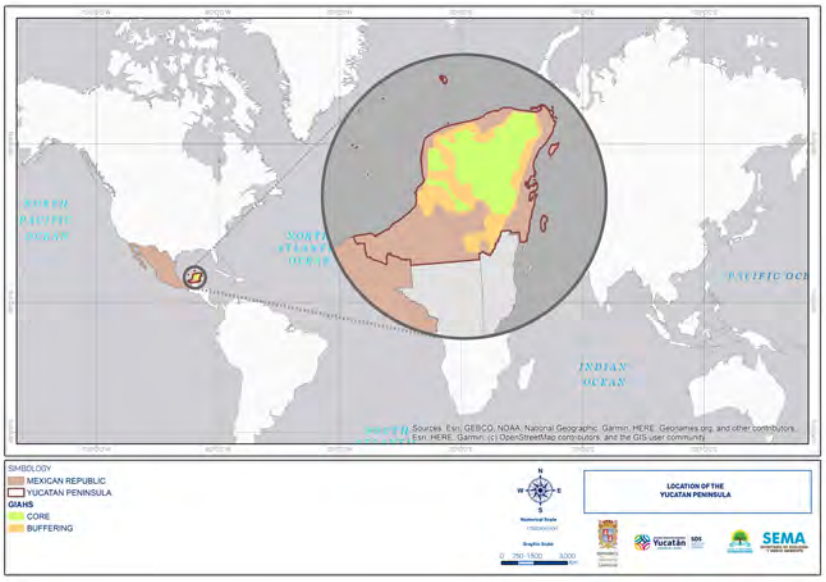


Name/Title of the proposed GIAHS site	Ich Kool: Mayan Milpa of the Yucatan Peninsula, México
Requesting Agency/ Organization, and contact information	Secretariat of Sustainable Development, Government of the State of Yucatan, on behalf of the Regional Committee on Climate Change of the Yucatan Peninsula. sayda.rodriguez@yucatan.gob.mx/desarrollosust@yucatan.gob.mx
Responsible Ministry (for the Government) and contact information	The Ministry of Foreign Affairs, Federal Government.
Location of the site: please annex land use maps and geographical coordinates of the site.	The proposed GIAHS site is located in Mexico, a Latin American country situated in North America. Mexico is bordered to the North by the United States of America, to the South by Guatemala and Belize, to the West by the Pacific Ocean, and to the East by the Gulf of Mexico and the Caribbean





Site Location

The Yucatan Peninsula comprises three states of Mexico, plus a department of Guatemala (Petén) and Belize. The total area is **16, 500, 000 ha,** of which the Mexican portion of the Peninsula occupies most of the area: 87% (14, 422, 059 ha), while Belize and Guatemala cover the remaining 13% (2,078, 000 ha) (Peter Bauer et. al.,2011: p. 53).[1]

The Mexican portion of the Yucatan Peninsula comprises the states of Campeche with an area of 5, 763, 442 ha (40%), followed by Quintana Roo with 4, 480, 922 ha (31%) and finally Yucatan which occupies an area of 4, 177, 695 ha (29%) (CONAGUA, 2021).[2]

The proposed GIAHS site is located in the southeast of the country in the Yucatan Peninsula, which is surrounded by the Gulf of Mexico to the northwest and the Caribbean Sea to the east. The geographic coordinates are: north 21.513449, south 17.979448 north latitude; east 87.130018 and west 90.689404 west longitude.

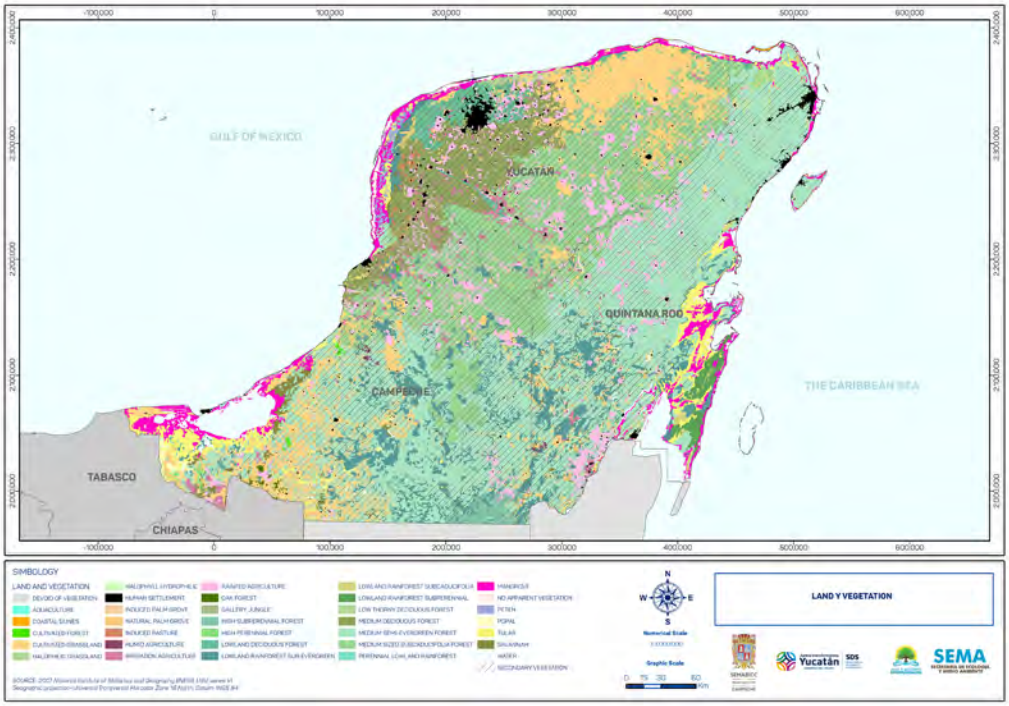
The proposed GIAHS Zone covers an area of **4,398,722.70 ha** that extends over the 3 peninsular states of the Mexican portion of the Yucatan Peninsula, occupying a large part of the State of Yucatan, part of the State of Quintana Roo and a smaller part of Campeche, representing **30.5%** of the Mexican portion of the Yucatan Peninsula.

1 Peter Bauer.Gott Wein.Bibi R. N. Gondwe. Guillaume Charvet. Luis E. Marín. Mario Rebolledo-Vieyra. Gonzalo Merediz Alonso. The Yucatan Península Karst Aquifer. En Hydrogeology Journal. May 2011. Mexico.

2 CONAGUA. Regional Water Program 2020-2024. Hydrological-Administrative Region XII. Yucatan Peninsula. Secretariat of the Environment. CONAGUA, Friends of Aian Ka'an, Yucatan Peninsula Watershed Council, Arronte River Foundation, Itaca Environmental. August 2021. Mexico

Land use and vegetation map

Map highlighting all relevant land uses related to agricultural activities including cultivated lands, pastured woods, grasslands, wetlands, swamps, water bodies, forests, urban areas and scattered settlements, agricultural arrangements (e.g., terracing, dry stonewalls, water courses, hedges, tree rows, etc.) Land use and vegetation map of the site:

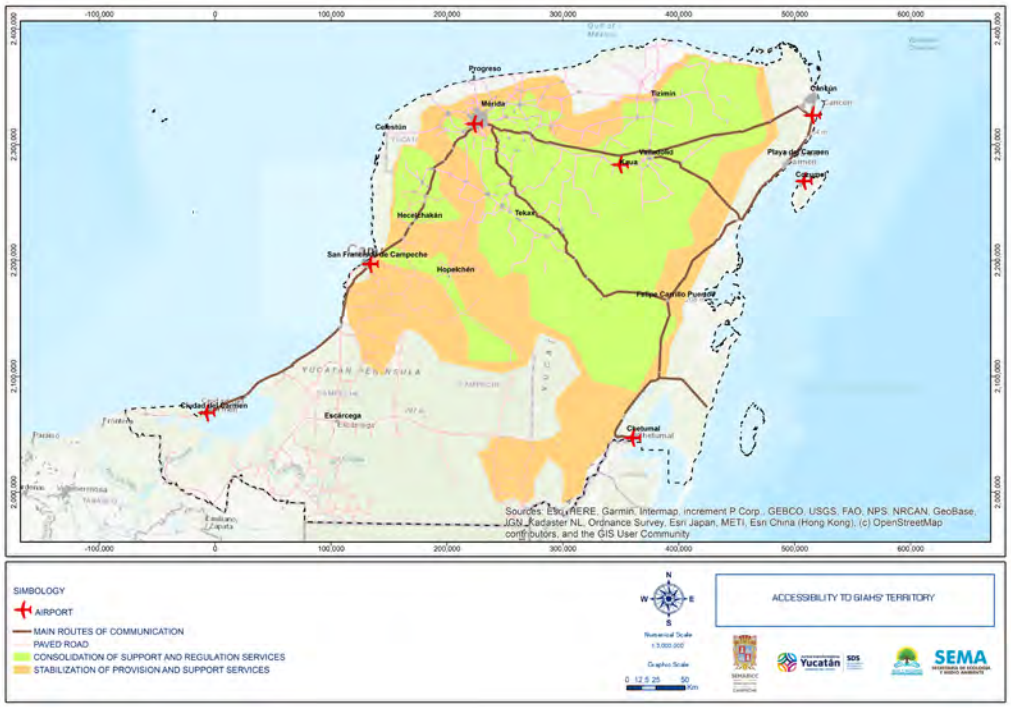


Vegetation of the core zone in the GIAHS proposal

Core zone vegetation cover	Ha	%
Rainfed agriculture and milpas	432, 154. 08	10%
Grasslands	353, 379. 88	8%
Secondary vegetation	2, 835, 626. 57	64%
Medium forest	555, 877. 59	13%
MISCELLANEOUS USES (urban areas, water bodies, wetlands)	221,683.86	5%
Giahs core zone total surface	**4, 398, 722. 70**	

INEGI (2018). Vector dataset of land use and vegetation. Scale 1:250 000. Series VII. National Set 2018 edition. Land Use and Vegetation information obtained from the application of photointerpretation techniques with Geomedian images with base year 2018, generated from the LANDSAT satellite constellation in multispectral format. Layer cropped according to the limits of the GIAHS core zone.

Accessibility of the site to capital city or major cities



The main cities within the proposed GIAHS polygon are:

A. Campeche: San Francisco of Campeche and Ciudad del Carmen

B. Yucatan: Merida and Valladolid

C. Quintana Roo: Cancun, Playa del Carmen and Chetumal

These cities are connected by federal highways

A. Ciudad del Carmen- Campeche

B. Campeche-Mérida

C. Mérida-Felipe Carrillo Puerto

D. Mérida-Cancún

E. Reforma Agraria - Puerto Juárez

F. Ramal a Playa del Carmen, Muna - Felipe Carrillo Puerto.

The main airports are

A. Cancun International Airport in Quintana Roo

B. Manuel Crescencio Rejon International Airport in Merida Yucatan.

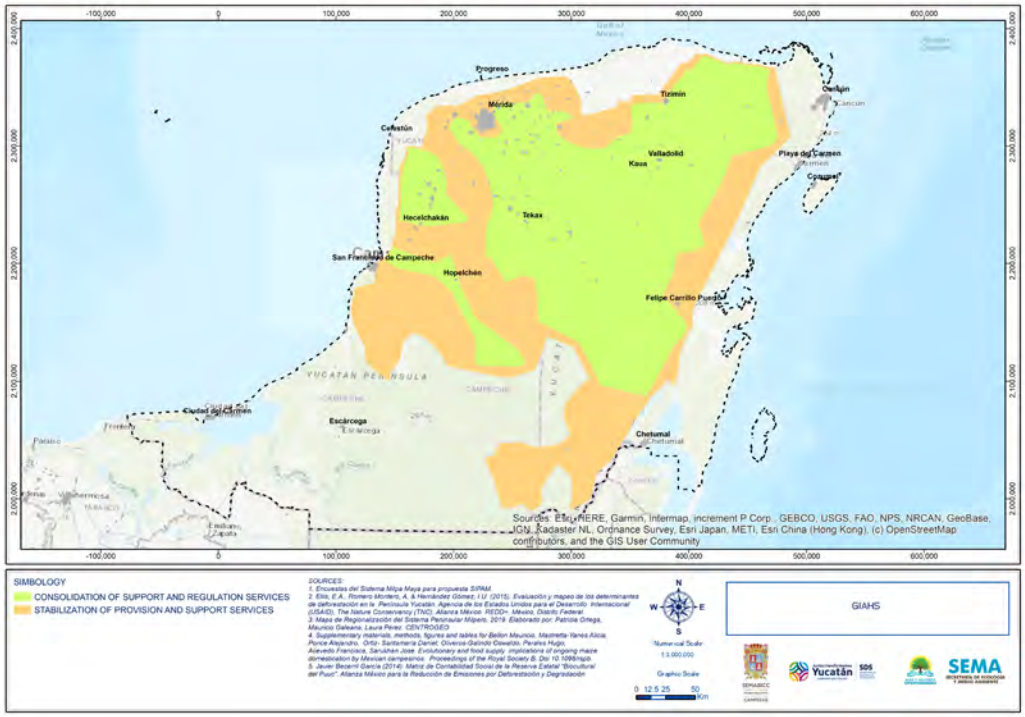
Area of coverage (expressed as "ha") of the GIAHS site (core area) and where necessary the buffer zone

Comparative table of the Yucatan Peninsula's surface dived by zones.

Zone	Campeche (ha)	Yucatan (ha)	Quintana Roo (ha)	Peninsula (ha)
Core zone	378,556	2,439,897	1,580,270	4,398,723
Buffer zone	1,406,929	826,440	1,075,455	3,308,824
Remaining Mexican Yucatan peninsular Territory*	3,941,509	652,601	1,792,859	6,386,969
Total ha.	5,726,994	3,918,938	4,448,584	14,094,516
% of the GIAHS core zone in relation to the total peninsular surface	**8.6%**	**55.4%**	**35.92%**	**30.5%**

*What we refer to as the "Remaining Mexican Yucatan peninsular Territory", which is not proposed as GIAHS surface, is the portion of the territory where most of the cultural forms of food production have been lost and have fallen under commercial agricultural practices, suffering a serious cultural erosion and a loss of agrobiodiversity germplasm, generating a process of migration of the original communities. Although it is still possible to find traditional milpa and agro-food practices, they are isolated.

The following is a map of the coverage area of the Maya milpa system:



Agro-ecological zone for agriculture, forestry, fisheries

Map of the agro-ecological zone (FAO):

The distribution of the areas with the greatest aptitude for crops, mainly corn and vegetables, depends on multiple factors associated with climates, soils (nutrients and oxygenation), ecosystems, and precipitation regimes. The map above shows the climatic regions, with the most favorable scenarios for crops that are associated with the tropics and highlands with more temperate and/or cooler conditions. It should be noted that this cartographic input is only taken as a reference to express the conditions in which the Yucatan Peninsula is contextualized.

Topographic features

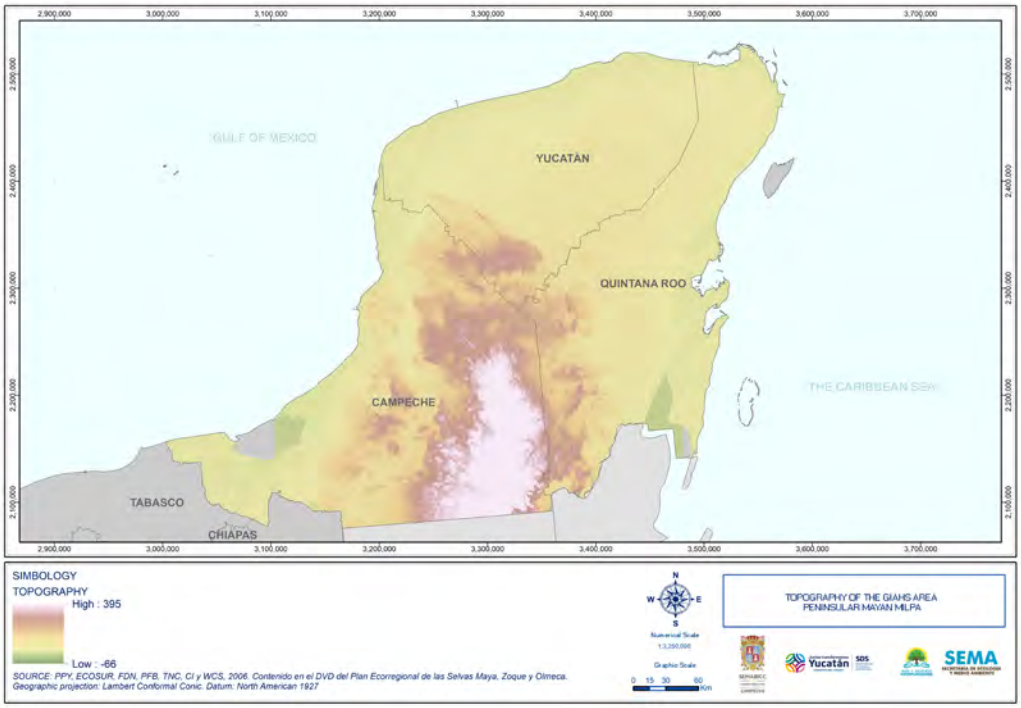
The Yucatan Peninsula has a uniform and relatively flat geological substrate of marine sedimentary origin which is composed mainly of calcium carbonate ($CaCO_3$) in the mineral form of calcite.

The dissolution of the substrate due to rainfall has resulted in the well-known karstification process that favors an infiltration and runoff of rainwater that leads in abundant groundwater and topographical formations, such as the so-called *cenotes*, hollows, caves, and caverns.

On the coast, there are ideal conditions for salt production, calcareous and carbonate sequences that form deposits of construction materials.

The peninsular topography has resulted in the formation of three major landscapes: Plains (5-40 m high) – Plateaus up to 200 m. high – and Valleys (10-30 m deep).

Topographic features



The geography and geomorphological features make the Yucatan Peninsula a particular territory, in which the climatic aspects corresponding to the neotropical zone intervene, creating unique topographic conditions and mesostructural landscapes. It is worth mentioning that most of the peninsular territory has a flat topography, with some elevations concentrated in the southwestern region, corresponding to the southern Maya zone, adjacent to the highland Maya. Nevertheless, the elevations registered in the peninsular territory range from 390 to 395 meters above sea level. A conditioning aspect for the tropical temperatures, and for the culture in general.

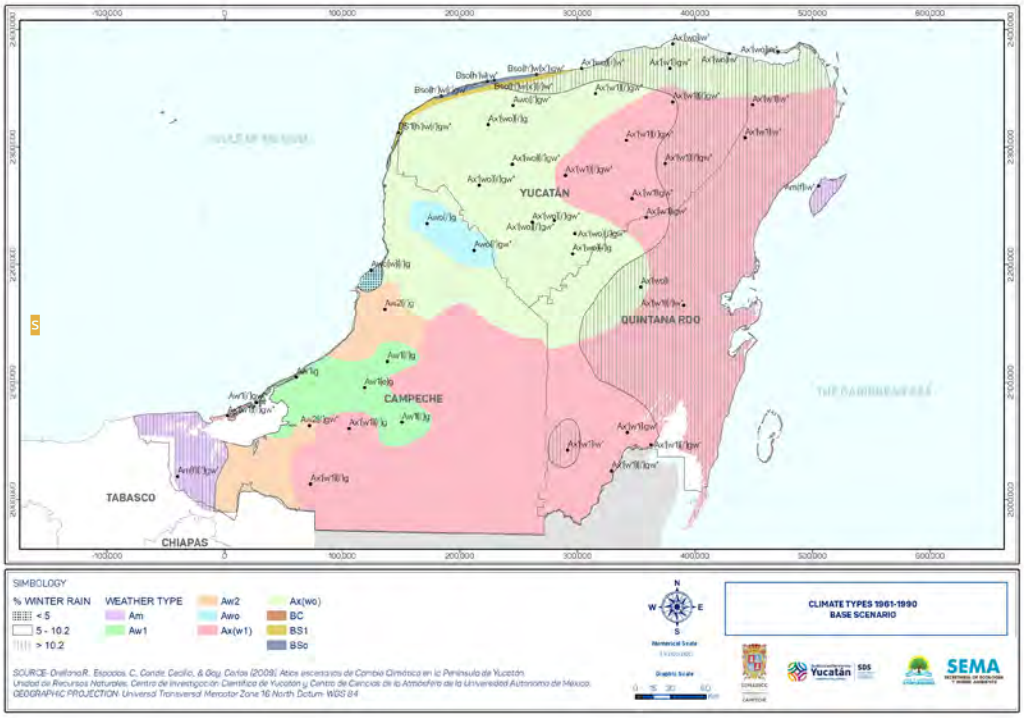
Climate type

The climate chart of the Yucatan Peninsula presents nine climatic subtypes.

- In the northwest of the peninsula: the driest of the semi-arid, warm with summer rains and intraestival drought.
- The following climatic type, from the area bordering the previous zone, is distributed between Los Petenes and Celestún to Dzilam de Bravo: it is the least dry of the semi-arid climates, warm with summer rains and intraestival drought.
- Southwards, there is a warm climate subtype, the driest of the sub-humid climates with evenly distributed rains and / or with a tendency to summer, with a high percentage of winter rains and intraestival drought.
- Between Hecelchakán and Bolonchén, there is another subtype of warm climate, equally dry with summer rains, but with a low percentage of winter rains.

Climate type

- In the city of Campeche and its surroundings, the climate subtype is very similar to the previous one, but with a very low percentage of winter rains.
- In the east of Yucatan, south-central Campeche and southwest Quintana Roo, there is an area with the intermediate warm sub-humid climatic subtype with evenly distributed rains and a tendency to summer, with a high percentage of winter rains and heatwave.
- North of Laguna de Términos, from the coast to the vicinity of Silvituk, is the intermediate warm sub-humid climate with summer rains.



Approximate population

Population data in the Yucatan peninsula and GIAHS core zone

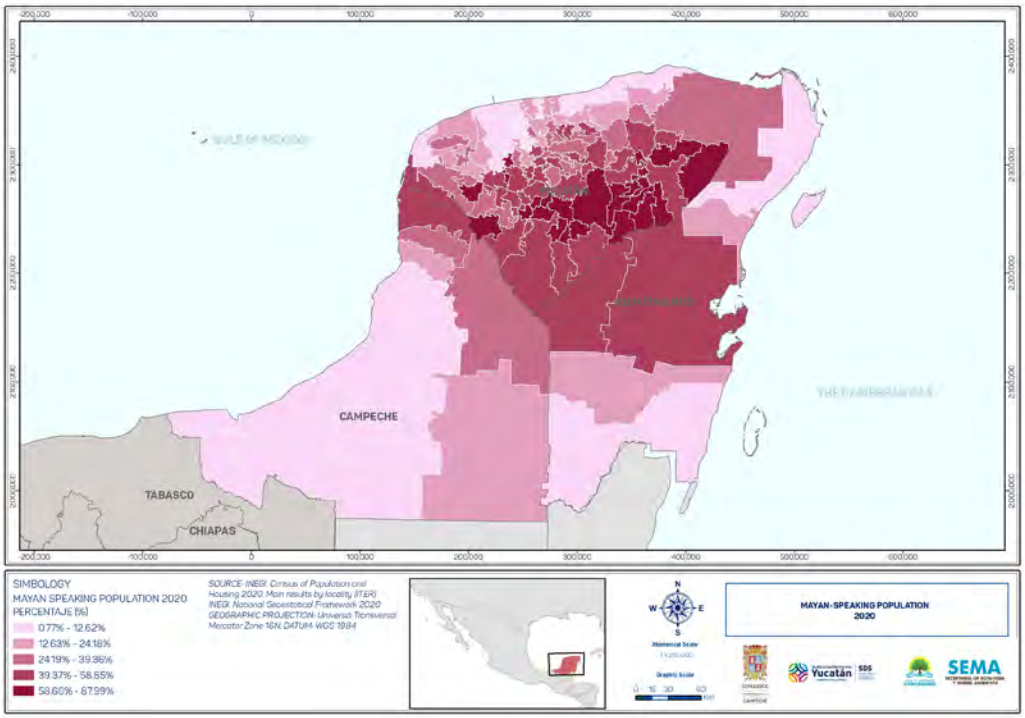
State	Population		Indigenous population		Milperos
	Total	Core	Total	Core	
Yucatan	2,320,898	919,673	525,092	388,032	324,105
Campeche	928,363	100,853	91,801	40,559	29,110
Quintana Roo	1,857,980	129,468	204,949	69,480	79,335
Peninsula	5,107,241	1,149,994	821,842	498,071	432,550

State	PERCENTAGE			
	Population of the state in the the core zone	State indigenous population	State indigenous population in the the core zone	Milpera population in the core zone
Yucatan	40%	23	74	75
Campeche	11%	10	44	7
Quintana Roo	7%	11	34	18

Ethnicity/ Indigenous population (if applicable)

Maya towns and communities in the lowlands / peninsula.

Map of the population of native Maya speakers in the peninsula in 2020:



MAYAN SPEAKERS				
State	Yucatan Peninsula		GIAHS core zone	
	Population	%	Population	%
Campeche	70, 603	10.4%	40,559	40%
Quintana Roo	204, 949	11%	69,480	54%
Yucatán	519,167	23%	388,032	42%
Oveall total	794,725	44%	498,071	43%

Source: INEGI, 2020

Main source of livelihoods[1]

Sources of monetary income differ widely between places. According to results of a study conducted in the core zone, income from wage labor plays a very important role, as do government programs, business and animal selling. Incomes from milpa and plot products are low. As sources of non-monetary income, on average one-fifth of total income corresponds to self-consumption of maize and about 15% represents consumption of solar energy and firewood.

The percentage of maize or grass for animal consumption represents 10% on average, and the equivalent value of grassland used for grazing corresponds to 26%.

The locations studied were rural indigenous communities, characterized by a high poverty rate, low education, limited infrastructure, few businesses, and a lack of access to quality medical, financial, and banking services.

The results showed that the sources of monetary income differ widely between places, but one of the main productive opportunities is to promote the field, and especially the Maya milpa, as this continues to be an important activity for all communities. (Rodriguez Canto A., et. al, 2016)

The income and expenses were investigated by means of an extensive questionnaire of the “Social Accounting Matrix”, applied to six communities in the milpa region, as examples of the core zone. For each community, a representative sample of production units was used, and the results of the questionnaire were captured in a database that was processed with the STATA 14 program. (Rodriguez Canto A., et. al, 2016)

For more details, see figures 5 and 6.

1 Rodriguez Canto A.; Gonzalez Moctezuma, P.; Montero Nava, R.; Flores Torres, J., Thuerbeck, N. González Iturbe, JA, 2016. Milpas Mayan and dynamics of land use in the Yucatan Peninsula communities. Mexico Alliance Regional REDD + and Yucatan Peninsula University Center of the Autonomous University of Chapingo. Merida

II. EXECUTIVE SUMMARY

In the milpa polyculture, maize, beans and squash are the principal crops.

CORN. PHOTO: THE NATURE CONSERVANCY

1. General explanation of the proposed GIAHS

Definition

The Maya milpa is a traditional agroforestry system, formed by a polyculture that makes up a dynamic living space of genetic resources. It is characterized by its knowledge and cultural adaptations, as well as its diverse strategy based on sowing a wide variety of plants (maize-beans-squash-and others), and carrying out multiple productive activities (diverse economy)[1].

The system is applied in plots under the technology of slash-and-burn of vegetation, in production it is customary to have years of output and years of rest between crops, leading to achieve fertility, reduce the destruction of weeds and the control of harmful pests.

Productive diversity is fundamental to the milpa family economy, including vegetable plots, orchards, animal husbandry and handicraft activities, among others. Activities derived from community forest management include firewood collection, lime and charcoal production, timber for houses, medicinal plants, hunting and beekeeping. This diversity of activities makes the milpa a complex system and a reference in the sustainable use of biodiversity.

Likewise, it is part of the Maya cultural heritage, with its language and its cosmovision. In its traditions are latent beliefs about the existence of supernatural and divine owners of nature, that are reflected in the agro-ecological practice and also through rituals, which have continued thanks to the values of solidarity, reciprocity and accompaniment of indigenous communities.

MAYA MILPA. PHOTO: MARIGEL CAMPOS CAPETILLO

1 The Maya area is part of Mesoamerica, where polyculture is also practiced, and it is one of the Centers of Origin of Domesticated Plants in the World.
Part of the information was obtained from the Infographic “Prácticas Tradicionales del Ciclo Agrícola de Comunidades Mayas del Sur de Yucatán”. Misioneros A.C. Guardianes de la Semillas, CONABIO, GIZ, et al.

The peninsular mayan milpa has sustained the population of the Yucatan Peninsula and still continues to do so, for more than 3,500 years, favoring the flourishing of the Mayan culture of the southern lowlands and conserving, thanks to its proper management, the jungle and biodiversity, even in a framework of stony karst soils and poor in nutrients and great climate variability. The jungle that still exists in the Yucatan Peninsula, has depended on the milpa system technology.

The Maya milpa has faced diverse situations and crises associated with population and agro-industrial growth, where the latter has led to the use of agro-chemicals, the loss of genetic resources, as well as labor migration and generation gap. This has affected the population, which has changed its diet, with considerable repercussions on its health. Faced with new perspectives on development and modernity, people are losing the knowledge of the traditional milpa and the culture surrounding it.

However, within this framework of challenges and threats, there have been experiences of adaptation of the Maya milpa, such as the insertion of some activities of the milpa economy (beekeeping, horticulture, forestry, handicrafts), which initially are for self-consumption and, at the same time, serve for the productive diversity of the system.

It is worth mentioning that strategies are currently being developed to strengthen the involvement of women and young people in the milpa system, since they play an important role in its functionality, as well as to promote gastronomic development and community tourism. In recent years, efforts have been formalized, focused on the conservation of the Maya milpa, with activities such as Native Seeds Fairs; a school of organic agriculture; the state germplasm bank in Yucatan, and the community and family seed banks, which have contributed to the participatory improvement of native seeds, and as a whole, to the conservation and exchange of community knowledge.

For this reason, the three states of the Yucatan Peninsula: Campeche, Yucatan and Quintana Roo, through the Regional Committee on Climate Change, agreed on the potential of the Maya milpa as a GIAHS site, and have therefore agreed to submit the present nomination. The proposal has the support of 771 signatures from representatives of milpa communities.

For this proposal, which supports the elements and guidelines for the recognition of the Maya milpa as a GIAHS site, the Action Plan for Dynamic Conservation of the Maya milpa (APDCMM)

3,500 years

Sustaining the population of the Yucatan Peninsula

MAYA MILPA. PHOTO: THE NATURE CONSERVANCY

was drawn up with the following aim: "To conserve and continue to develop the agro-ecological and cultural experiences of the peninsular Maya milpa, driven by policies culturally appropriate to the milpa system, to recover self-sufficiency, ensure the conservation of biodiversity and rebuild the territory as a common good".

The APDCMM is the result of continuous collective work, joint visions and socialization of all the actors involved, likewise, it remains open to feedback at all times and to be improved according to the needs and requirements of the farmers, *milperos* and milperas, who are the heart of the Maya milpa system.

2. Global Significance

The milpa was created by ancient settlers of Mexico, and was the case of the Yucatan Peninsula, which led to the development of the first towns of the Maya civilization. Today, the Maya milpa is seen as the center of a broad productive system that also includes hunting, the raising of Melipona or native bees, edible home gardens and harvesting in the forest.

The aspects that stand out of the global importance of the peninsular Maya milpa are: having a proven sustainability of at least 3500 years, having developed in a unique karst region, being located in Mesoamerica, being a large cultural area considered as a center of origin of domesticated plants, and containing, although fragmented, the most extensive milpa area in the country, extending from the state of Campeche to Quintana Roo, through Yucatan.

As a system, it has produced genetic material adaptable to drought and pest conditions, which is not negligible in the current climate change environment. It is highly resilient and has maintained vegetation stability because it integrates the forest into the system, which through sustainable use can ensure its conservation, and hence the carbon sequestration, in benefit of biodiversity.

The milpa has not only produced food, but also identity and culture, it has offered complete and quality nutrition and has allowed evolution with the productive diversity of edible home gardens Its gastronomy represents an outstanding contribution to world cuisine, being an important part of Mexican gastronomy, which is recognized as Intangible Heritage by UNESCO. Finally, the Maya milpa is based on ancestral knowledge and indigenous recognition, from which the philosophical and spiritual foundations and premises of the system are born, that have managed to maintain its essence over the years.

3. Characteristics and Relevance to the GIAHS Criteria

The milpa contributes to the sustenance and food security of local communities; its diet contains a large part of the food requirements that the human body needs, which has favored both self-consumption and the transfer of surpluses outside the community through the milpa agro-food polyculture, in addition to being strengthened through the diversity of productive activities that make up the system.

Regarding agro-biodiversity, the milpa system has favored the cultivation of domesticated species and variants, some of them native to the Maya area (cacao, henequen and “ibes”, among others) and others from the Mesoamerican area in which the Maya milpa is inscribed, such as maize. The management that has been carried out under slash-and-burn for thousands of years in a controlled manner and lately under continuous land use, has favored the conservation of the biodiversity of the Maya Forest.

The selection in each milpa, at the same time, has promoted the enrichment of the cultivated genetic resources, for example through the selection and conservation of seeds. The management has contributed to forest regeneration and the buffering of the effect of fires, the aftermath of hurricanes. The Maya milpa landscapes have been preserved with apparent stability, although they are very dynamic, and are part of the traditional landscapes of the region, as well as the Maya ruins and subterranean karst landscapes (*cenotes* and caverns), also forming part of the world’s biocultural heritage.

There are traditional, community and family rules for the use of the forest, being the value systems and cultural practices (ritual and religious), the most related to the use and management of resources, based on a collective heritage.

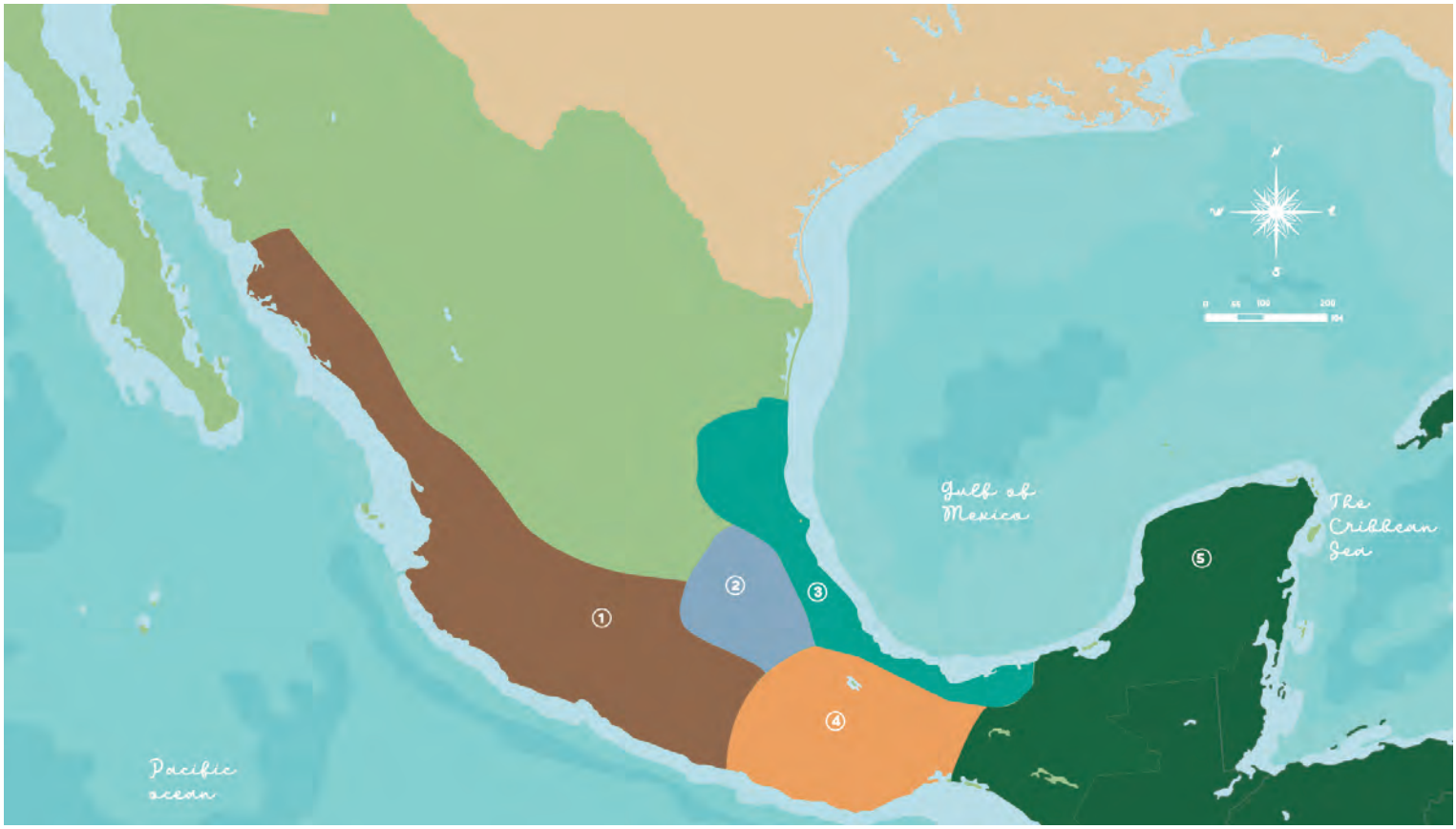
To date and for some years, many social organizations have converged with governments, civil organizations and academia to contribute to the adaptation of local family agriculture to the changing conditions faced by indigenous and milpa communities today. Having the common aim of supporting the recognition of the Maya milpa, through the conservation and development of agro-ecological and cultural experiences.

MILPA LANDSCAPE. PHOTO: THE NATURE CONSERVANCY

III. SIGNIFICANCE OF THE PROPOSED SYSTEM

Part A. Values/Specific Features of The Proposed Sites as Global Importance

III.A.1 The Milpa in Mesoamerica



MAP 1. MAP OF MESOAMERICA

SYMBOLOGY

1. WESTERN MEXICO
2. CENTRAL PLATEAU
3. GULF COAST
4. OAXACAN REGION
5. MAYAN REGION

SOURCE: Kirchhoff 1943
Coordinate System GCS WIGS 1984
Datum WIGS 1984
Units Degrees

The peninsular Maya milpa is an agro-ecological and sociocultural (biocultural) system found in the Mexican Maya area and is part of the Mesoamerican milpa, present throughout the large cultural area known as Mesoamerica (Kirchhoff 1943), since the beginning of the Mesoamerican civilization around 2,500 BC.

Today, the milpa is found in some portions of this area, including the Yucatan Peninsula.

In ancient times, the milpa was the basis of all Mesoamerican societies and cultures. Nowadays, it is the biocultural base of the cultural communities in which it still lives. The Maya milpa is not only an agricultural system, but it is also the foundation of the production and the sociocultural system (Terán and Rasmussen, 2008).

Maize is the most important plant in the milpa. It has:

60

breeds, of wich 59 are native

III.A.2 Mesoamerican Milpa as an Agricultural System

III.A.2.1 Polyculture Technology

As an agricultural system, the milpa polyculture with maize (*Zea mays*), beans (*Phaseolus spp*), and squash (*Cucurbita spp*), cultivated in association, is the key technology of the system and to which it owes its name. However, polyculture includes many other species and varieties that have been and are different in each ecosystem and culture of Mesoamerica.

Maize, beans, and squash, the Mesoamerican triad found in all milpas, complement each other ecologically and nutritionally.

Ecologically because the maize supports the bean that climbs on its stalk, the bean provides nitrogen to its associates, and the squash with its crawling vines, provides moisture to the soil and repels insects and bugs with its cucurbitaceous.

Nutritionally because the three species of the polyculture contain all the nutrients that the human body needs to live: proteins, carbohydrates, minerals, fats, and vitamins. Without this, the development of a civilization such as the Maya is unimaginable. It is important to know that maize has historically undergone a process called nixtamalization, which releases its husk and niacin (vitamin B complex) so the body can absorb it. See *IV 1.2 Food Security and Livelihood Security*

In each system that has developed, the milpa polyculture has adapted to these ecosystems, which has generated a great diversity of cultivated genetic material. For this reason, Mesoamerica is among the 12 major sites of origin of domesticated plants on the planet (Vavilov, 1949). It contributed to over 200 species to the world.

Maize, which is the most important plant in the milpa, since it provides the main food, has over 60 breeds – of which 59 are native (Sánchez et. al., 2000), adapted to different altitudes, climates, and soils, and within the breeds there are also variants. Maize, that grows in the Sierra of Puebla, does not grow in Yucatan and vice versa. This means that although there are milpas all over Mesoamerica, each milpa is different.[1]

1 In view of the great diversity of maize, the American maize researcher said in 1946 “There are often many more types of maize in a single locality in Mexico than in the entire United States” (CONABIO, Biodiversidad Mexicana, Diversidad Natural y Cultural del Maíz).

III.A.2.2 Artificial Selection Technology

The artificial selection of plants has been the primary tool of the milpa system to adapt them to the ecological (climate, soil, altitude) and cultural (culinary, rituals) conditions of the ecosystems and cultures in which they have developed.

This process is carried out every year by each *milpero*. They select those plants that have the best characteristics of the aspect considered (resistance to drought, size, resistance to humidity, etc., or better flavor, texture, color, etc.), and these are the ones that are sown, so each milpa can be considered as a long-term biotechnology laboratory.

This factor is essential for understanding the system's significant contribution to the global stock of cultivated plants.

III.A.3 The Peninsular Maya Milpa

The Yucatan Peninsula is currently the portion of Mexico with the largest presence of milpa, in the second largest forest of the American continent–The Maya Forest- after the Amazon Forest.

The Maya milpa system has proven to be sustainable for at least 3,000 years (see III.C). For most of its existence, the Maya milpa system has generated enough food for household consumption and surpluses to transfer to other societies as taxes or trade. The food source sustained the vast peninsular Maya civilization that built monumental cities with large stratified and specialized populations, and a high culture with considerable complexity and refinement. It also sustained the colonial population for three centuries, the 19th century society, and the peninsular inhabitants during most of the 20th century.

Few such systems have flourished in such limiting conditions as those of the Yucatan Peninsula, where the soil is thin, stony, and poor in nutrients, and the area has high climate variability, a warm-humid climate, with deciduous forests and semi-deciduous soil conditions (see III.C).

MAYA MILPA. PHOTO: MARIGEL CAMPOS CAPETILLO

This millennial sustainability is a fact of global importance.

III.A.3.1 Ecological Limitations of the Peninsular Maya Milpa[1]

The Mexican portion of the Yucatan Peninsula has an area of 14,422,059 ha, comprising the states of Campeche (5,763,442 ha), Quintana Roo (4,480,922 ha) and Yucatan (4,177,695 ha) (CONAGUA, 2021).

It is located in a tropical zone dominated by warm climates (Aw and Ax) and a dry climate in the northwest corner (Bw) There is no frost, and there is between 1000 and 1200 mm. of average rainfall with

1 We refer here briefly to the limitations of agriculture. To learn about these features in more detail, refer to the report presented by Rodriguez, A. et al, 2016. PP. 184-201. We also take data from other sources.

a high relative humidity. Rainfall is distributed in a northwest-southeast gradient, so forests also have a similar distribution gradient. In the northwest corner, where the climate is dry, the vegetation is mainly xerophytic plants. The annual temperature is 26 ° C. The prevailing weather and temperature promote agriculture pests.

There are two seasons: a rainy season, from June to November, and a dry season, from December to May. The pre-summer drought, one of the two annual dry episodes characterizes by being long-lasting and slow. The intraestival drought, known as heatwave, is often shorter, but extremely intense and can have catastrophic effects on developing agriculture, as gleaning maize, and sometimes crops may be lost. This occurs between July and August.

In summer and autumn, tropical cyclones form in the Caribbean Sea and the Antilles, which occasionally strike the peninsula. Forest devastation by hurricanes and subsequent fires is an important part of the environmental constraints (Rodríguez, A., et al., 2016). In winter, cold air masses called *Nortes* come from the northern United States and southern Canada (Romero, D., s / f).

Besides erratic storms, critical and prolonged droughts, and pests and hurricanes, soils have been a major constraint to agriculture. The Yucatan Peninsula is the youngest part of the country (13 million years) so soils are young, shallow, and stony, except in the south and east of the site.

The peninsula Maya milpa is located in a karst, the Maya craton, which is the largest continuous limestone outcrop in Mexico. The region's elevation is low, and the soil surface is permeable. There are no surface water sources, but an extensive groundwater supply is readily accessible in many natural sinkholes, called *cenotes*, and in artificial reservoirs, called chultunes. Over time, the peninsula's soil limitations have created resilience and determination in he *milperos* of Yucatan, one more detail that helps to explain, the resilience of the system. Successful subsistence in such a tough environment is something to be considered of global importance.

The Mexican portion of the Peninsula has sub-deciduous, medium and low deciduous forests and an extensive secondary vegetation, which results in agricultural rotation due to slash-and-burn activity (SEDUMA, 2015).

In this ecological context, we will describe the remarkable aspects of the milpa system in its different aspects: as agricultural, productive and cultural, philosophical or cosmological, social and economic.

III.A.3.2 The Yucatecan Peninsular Milpa, Polyculture Technology, its Species and Variants. Nutrition and Gastronomy

Based on what has already been discussed, we can define the peninsular Maya milpa as an agronutritional, agroecological, agroforestry, productive and sociocultural system, which has the polycultural milpa as its core. This core is formed by the plants of the Mesoamerican triad: maize, beans, and squash as well as "Ibes" white broad beans (*Phaseolus lunatus L.*), which increases the core triad to four crops in the Yucatan Peninsula (Rodriguez, A., et. al., 2016).

Besides the core species, sown in association in the same hole, there are many other species that have been sown in the milpa itself, intercropped, as other beans and cucurbita species, and those sown in the so-called *pach pakal*, where vegetables and roots are grown, taking advantage of the best soils of the milpa. Another cultivation space that is part of the milpa system is the polyculture of the plot.

We have recorded 32 species with nearly 100 variants in the Yucatan milpas (Teran and Rasmussen,1994)[2]. The milpa polyculture also grows variants, in cycles (short and long) of maize and other species, allowing small crops to be planted and harvested throughout the year. This can be done

2- In a more recent record southern Yucatan, they reported even more plants than the Teran and Rasmussen report (Rosales y Vargas, 2020).

in two, three, or even more milpas simultaneously.

Regarding maize, it is important to point out that there are drought-resistant varieties, which have been forged by *milperos* through a thousand years of artificial selection, to resist the lack of water. Besides its adaptative qualities, milpa plants cover all nutritional requirements, as we already said, but it has also generated a rich gastronomy.

The gastronomy derived from the milpa is an outstanding contribution to world cuisine. Mexican food (which is Mesoamerican) has already been recognized as Intangible Heritage by UNESCO. In this tradition, the cuisine of the Yucatan Peninsula has stood out because of its diversity and flavors. The origin of this fine cuisine is the milpa, and is enriched by other traditions such as Iberian and Lebanese, in the case of Yucatan peninsula.

The contribution to the world's genetic wealth, complete and healthy nutrition and rich gastronomy are aspects of global importance.

WOMAN IN THE MAYA MILPA. PHOTO: THE NATURE CONSERVANCY

III.A.3.3 Why do we slash and burn vegetation in the peninsular forest?

Yucatan is a land of the scarcest soil that I have ever seen, because all of it is a living flagstone, and it has marvelously few soils, so much that there will be few places where one can dig without coming up against great banks of very large flagstones.

The stone is not very good for delicate works, because it is hard and coarse; however, as it is, it has been so that from it they have made the multitude of buildings that exist in that land; it is very good for lime, of which there are plenty,and it is a marvelous thing that this land is sofertile on the stones and between them.

Fray Diego de Landa
Relación de las Cosas de Yucatán (Summary of the Things of Yucatan)
Century XV

The milpa in the Yucatan Peninsula has been carried out under the technology of the slash and burn, because it is not possible to apply any other technique in its stony and thin soils, which inspired the description above, made by Bishop Landa, when he first visited Yucatan.

This technique has been necessary not only to open up space in the vegetation for crops and allow the sun to enter, without which they could not grow, but also, and inevitably, to incorporate the nutrients accumulated in the vegetation into the stony, poor and thin soils of the Yucatecan forest. There, the nutrient cycle - which is very fast due to the heat and humidity - means that they are either quickly taken up by the vegetation or are lost by absorption (leaching) from the porous and karstic soils and, therefore, the soil does not accumulate them. The result is poor soils and abundant vegetation, due to their rapid and efficient capture of nutrients. We could say that the fertility of the forest is not in the soil, but in the vegetation.

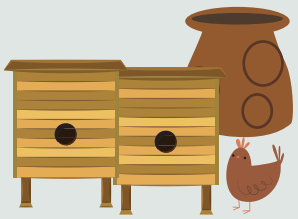
The stoniness and lack of soil have prevented the entry of plows and tractors (except in certain portions of the south where there is more soil because it is older than the Yucatecan Plain) and for 3500 years a simple wooden planting stick has been used for planting.

In the Yucatan Peninsula, plots are cultivated for 2 or 3 years and then

Multiple

productive

activities take place in the forest, important parts of the milpa system, while vegetation and fertility recover.



MILPERO SOWING WITH XUUL ON STONY SOIL. PHOTO: CHRISTIAN RASMUSSEN.

abandoned because plant competition increases and the work of weeding no longer compensates for the yields. It takes 16-18 years for disused plots to reach stability and promote good fertility by slashing and burning again after that time. During the recovery time of the vegetation of a disused plot, the Maya make extensive use of forest vegetation for firewood, charcoal, poles, construction or repair of houses and elaboration of handicrafts or work tools, for hunting and to establish their apiaries. After burning, the trunks and branches that did not turn into ashes are used as firewood for the milpero's house.

Burning vegetation, although it causes nutrient loss, has been the only way to clean the soil and to incorporate nutrients that are not lost by high temperatures, such as potassium, nitrogen and phosphorus. In addition, it helps to eliminate weeds and disinfect the soil of pests and diseases (Acosta et al., 1984). For this reason, they were able to grow crops for millennia without the need for fertilizers, herbicides and pesticides.

There are also many environmental benefits derived from slash-and-burn techniques that we describe in other sections of the paper. See (IV 2.2 and IV.3.2).

Milpa under slash-and-burn in the GIAHS Core Zone

The relation between milpas open to cultivation and forest has always been smaller, because the plots under cultivation are always small and the plots in disuse are more.

In the GIAHS core zone, there is a smaller proportion of milpa plots open to cultivation (10%), compared to the area occupied by Medium Forest (13%) and Secondary Vegetation (64%), formed by plots in disuse and in vegetation recovery, which exist thanks to the predominance of milpa under slash and burn.

The large presence of Medium Forest and Secondary Vegetation, exists due to the predominance of the Milpa under slash-and-burn, which, as reflected in the percentage, occupies less space (10%), while the largest percentage (64%) is occupied by the Secondary Vegetation formed by the disused and recovering milpa plots. The Medium Forest (13%) occupies a higher percentage than the milpas open to cultivation and fortunately the pastures still represent the lowest % of coverage, which indicates that there is no significant presence of livestock.

Core zone vegetation cover	Ha	%
Rainfed agriculture and milpas	432, 154. 08	10%
Grasslands	353, 379. 88	8%
Secondary vegetation	2, 835, 626. 57	64%
Medium forest	555, 877. 59	13%
Miscellaneous uses (urban areas, water bodies, wetlands)	221,683.86	5%
GIAHS Core zone Total surface	**4, 398, 722. 70**	

All of the above explains why the milpa under slash-and-burn has favored the survival of the forest in the Yucatan Peninsula and of the Mayan culture that defines the milperos that inhabit it (see the graph of the correlation between slash-and-burn, forest conservation and culture in Annex 6).

III.A.3.4 Fallow Land, Forestry and Milpa as Productive System

Understanding fallow is the first step in comprehending why milpa technology is considered not only the core of the agricultural system but also the core of the Maya productive system.

Multiple productive activities take place in the forest, important parts of the milpa system, while vegetation and fertility recover. Land-base fallow activities have been described in terms of their relationship with the milpa. This is because the milpa is where food mainly comes from, and has traditionally imposed its pace and needs on the Maya[1].

It is worth mentioning that the 16–18-year fallow not only serves to enhance forest recovery, but has traditionally allowed for many agroforestry activities, some of which also provide food, such as beekeeping and hunting[2]. Other activities provide the raw material needed to make instruments, furniture, utensils, and houses, or for medicine, foraging, tanning and, indeed, as firewood. Kilns are also made for lime and charcoal production, -both important for food processing- and for extracting non-renewable resources such as stone and *sahkab*[3].

Thus, the soil "at rest" is not idle land, but continues to provide multiple resources for subsistence agriculture.

III.A.3.5 The Plot and Milpa as Productive System

The other step to understand the milpa, not only as an agricultural system but also as a productive system, is the plot and all the productive activities that are developed in this space by the milpa family.

As in the forest, there are several productive activities in the plot.

The arboreal vegetation, in addition to providing food with its fruit trees that can be consumed or sold, also provides shade and protection. Unlike the milpa and *pach pak'al*, where the work is performed

1 This began to change 40-50 years ago when fallow times started to be reduced due to decreasing the availability of land.
2 In colonial times cattle ranching was also carried out in the forests, this continued until the last century with a law that required cattle to be kept in an enclosed area in 1972 (Rosales, M., S / f) was approved
3 It is white, limestone soil that abounds in Yucatan and is mixed with lye and used in masonry. It is also known as saskab.

only by the adult males of the family, the vegetables cultivated in the plot are grown and cared by all family members, especially women. The plot is also a breeding ground for animals as turkeys, pigs, chickens, ducks, native bees and eventually, cattle. In the plots, we find a wider use of both plant and animal genetic material of external origin. The plot is also the place where handcrafts are elaborated by one or several members of the *milpero* family and one way in which family earns money.

Throughout its history, the plot has been considered as most dynamic in terms of its organization; it produces multiple goods and is a space that allows for the satisfactions of daily life. Its existence supports the diversification and increase of small family incomes.

The milpa-plot combination is a highly productive unit that could achieve self-sufficiency in food production for rural families (See section IV. 1.2)

MILPEROS. PHOTO: THE NATURE CONSERVANCY

III.A.3.6 Ecological Knowledge: Basis of the Milpa Technology

It would be impossible to imagine milpa technology (artificial plant selection, adaptation to ecological characteristics) and the slash-and-burn technology, without an effective knowledge of meteorological phenomena and landscape features, so ecological knowledge has been a major tool of the milpa agricultural system.

For this reason, we find important environmental knowledge that *milperos* transmit generation after generation in an oral and practical way as: a typology of rain and clouds (16 types) (Terán y Rasmussen, 2008), the *xok k'iin*, -the counting of days, or Maya weather prediction-; knowledge of the different vegetation, *monte*, or *k'aax* and plant succession; knowledge of almost 20 types of soils (Bautista et. Al., 2012). This is of global importance because without this knowledge, it would be impossible the main practice, which is to use the correct seed in the proper ecological site, and to shape, by artificial selection, the seeds they select to sow each agricultural site.

The ecological knowledge generated to implement the system is described in the fourth (IV) chapter of this document.

III.A.3.7 Philosophical Premise of the Milpa System: Cosmology and Rituals

The cosmovision and ceremonies result from the relationship established with nature through milpa management has been fundamental to the system's way of existence. This is described in chapter fourth (IV). It is not secondary information. It is the philosophical basis of the system and it is essential to understand the system rationality.

From the point of view of Maya cosmology, the forest has its spiritual guardians, but it also has a consciousness. In a word, we can say that nature is a subject, not an object, and human beings have to negotiate with this subject to use its resources. This is the basis of human existence because all the means of existence come from it. For this reason, they organize rituals and ceremonies to ask permission and thank the use of nature to the supernatural powers that possess and care for natural resources (Terán y Rasmussen, 1992).

The Maya have a deep respect for nature since time immemorial and this respect is the foundation of their philosophy, cosmovision, religion, natural resource management, and sustainability.

III.A.3.8 The Milpa Family

The family is the economic unit that performs the different tasks in the milpa, as well as its many productive activities. This is a strength of the system. The biological bond creates a cell of great solidarity, cohesion, and social and economic adaptability to any crisis (Canul, 2016).

The size of the milpa that the family can cultivate depends on their consumption needs and labor. These aspects rely on the age and gender of the family members, and the stage of family life.

The amount and organization of multiple family activities also influence, depending on the number, age and gender of members (Teran and Rasmussen, 1994).

Although the nuclear family comprising father, mother, and children is the basis of the family, the extended family formed by aunts, uncles, cousins, and grandparents has been central to family life because it is an important resource when additional labor is needed. Close family friends and additional acquaintances are another potential labor resource. In some communities, woman are now "ejidatarias" because they are widows and inherit their husbands rights

III.A.3.9 The Milpa Community

Milpa families live in communities. The community is the social context in which the milpa family develops and the social unit through which the family can access land.

The Agrarian Law exists to regulate land use. However, this law has been combined with the slash-and-burn system, which does not favor land division because historically there has not been a continuous land use, it has been an itinerant agriculture.

Therefore, in most of the peninsular *ejidos* -the collective land use derived from the 1910 Revolution-, there have been internal rules which establish that everyone can work the land, even if they do not possess agrarian rights. *Ejidatarios* are those who have a recognized right, while the rest are called *comuneros* (CRUPY: 37). These *comuneros* are mostly *ejidatarios*' sons. These young men perform certain tasks and labors that they call *fajinas* to earn the right to use the common land. If they cannot perform the tasks because they migrate for work, they pay someone else to do it for them. In some communities, woman are now "ejidatarias" because they are widows and inherit their husbands rights.

Another rule that has operated in land use is the "family milpa zone," which is a form of "ownership" of land by large groups of families. This is a custom that has its roots in pre-Hispanic times.

It is practiced and accepted by all the peninsular Maya towns.

III.A.3.10 The Milpa Cycle

The milpa, as an agricultural system, is established and managed as follows:

Site Selection

Ximbal K'aax. Walking in the forest to select the plot to be cultivated.

Breaching

Jol Ch'ak. To indicate that the site has to be chosen, a path is cleared around the selected rectangular or square area with a machete or hoe.

Measuring

We P'is K'aax. The area is measured and divided into sections called *mecates* of 20 m. x 20 m. with rope, this defines the amount of land to be worked. It ranges from 2 to 4 ha.

Clearing

Kol. The vegetation of the selected land is cut down with a bat, machete and / or with a hoe and axe. The procedure, working hours, and instruments used for this practice vary according to the vegetation of the soil and the time of year.

It is customary to leave trunks between 0.50 and 1 mt. to promote vegetation regeneration (look after details on page 108). This practice is considered of global importance because it has implications for forest conservation.

Guardrail

Mis pach kol. Before burning the vegetation of the future milpa, a strip of surrounding vegetation is cleared (0.75 cm to 2 m) to create a fire safety barrier.

Burning

To'ok. When the vegetation is dry and the rains approach (mid-March to mid-May), the burning season begins. During this time, winds coming from the south, southeast, and east blow strongly and evenly. When the *milpero* believes it will rain and it has been sunny for at least a week, he chooses a day, preferably a sunny one, and prepares for burning. The land must be dry and warm. At the end of burning, a count is made of the burned animals, to ask forgiveness from the supernatural owner of the land animals, *metan lu'um*, during the rain ceremony. (See Chapter IV)

Seed Selection

The seed preparation is a strategic step of the milpa technology, being the polyculture, the principal instrument of this agriculture, and being the artificial seed selection, the key tool for environmental and cultural adaptation of the plants. This step begins during the harvest and includes two aspects: 1) the obtaining, selection and shelling of the maize to be used, and 2) the collection and preparation of the associated seeds, or *xaak'* in Mayan, which is the set of seeds that accompany maize and that are sown in the same holes. (See Chapter IV)

We consider this process to be one of the most important aspects of milpa technology and of global importance because, although it is a process found in all Mesoamerican milpas, as we have told before, each milpa is unique because it develops in different ecological and cultural conditions, and it is important to observe the particular aspects that make up the selection processes. (See Annex 1. Table with milpa seeds).

Sowing

Pak'al. After the first two or three rains in May June, the main sowing begins. Sowing includes maize

and other associated species and varieties of squash, beans and ibes. In the pet pach or pach pak'al, site that takes advantage of the best soils of the selected plot, they use it to sow roots and vegetables. It includes a diversity of maize that is sown simultaneously. They do several sowings at different times, considering the type of maize and the type of beans and roots, but the main sowing is done in May-June (See chapter IV). This is a fact of global importance because it is a way of conditioning food security.

Ch'a Chaak and Individual Rituals

After sowing, a community ceremony is held, (called *Ch'a Chaak*) to inform all supernatural beings related with the milpa harvest success, (God, Virgin, and Saints, and particularly to the rain Gods and Goddesses, and all the supernatural beings who care for the forest, that the sowing is over and now it is time for them to work and ask them to send good rains). And as the maize grows, individual rituals are performed in the milpas to demand that the crops be protected from animal attacks (See chapter IV)

Fertilization

[1]This practice became widespread in the early 1970s. It has been promoted by official agricultural institutions through credit loans. Fertilization is applied before the first rains after sowing.

The Weeding *Pa'ak kol*

This is the handmade weeding with the help of a hoe in the milpa or in the pet pach. This weeding uproots the vines. There is another type of weeding, less radical (*jaranchak*'), which does not uproot the vines and is preferred in our times when the use of herbicides has appeared and spread.

Punishments Period

There are many potential threats to milpa crops, as drought, pests, diseases, predator attacks, and hurricanes, from the sowing stage to the consumption stage. These threats are frequently seen as divine punishments by *milperos*. Nowadays, all these attacks are faced with drought-resistant maize, with medicines, with organic methods, with rituals. The Maya peninsula has always been vulnerable to these attacks because of humidity and climate variability, but today, the vulnerability of the region has increased with global warming and with the decrease of fallow land (See chapter IV).

Thanking the Ripening of Corn or *Holché* or *Ujanli Kol*.

Three months after sowing, when the large corn, or xnuk nal, ripens, each *milpero* and his relatives perform, in the milpa field, this ceremony of gratitude, before consuming the corn.

Fold, *Wats'*

It comprises bending the cornstalks of the 1st year milpas without cutting them, to protect the milpa while the corn is dried and harvested on a large scale, three months later. The 2nd and 3rd year milpas are not bent, but are harvested directly for consumption.

The beneficial effects of this practice are that it is more easily collected (Hernandez, 1981; Arias 1980;Aban, s / f); it provides protection against cyclone and winds (Hernandez, 1981; Arias, 1980); aid for the development of associated crops and supports the *tsama* beans (See chapter IV).

1 This practice began in the 1970s and has been increasing over the years. It started due to the decrease of forests caused by population and cattle ranching growth. At that time, tourism and Cancun began to be promoted and the *milperos* would go to work to be able to buy fertilizers and herbicides, since the presence of weeds has become more common because of the reduction of fallow times.

Harvest, *Jooch*

Because many crops are grown in the milpa, the harvest time is very wide and variable because it involves species and varieties of different maturation cycles.

The large corn harvest (harvested in January) is the most important. But the milpa harvest potentially extends from June to March, and even up to May, considering all the plants that make up the polyculture. The possibility of having crops practically all year-round is important to understand the old safety mechanisms that the milpa strategy puts in place to ensure food security. Currently, with the existence of new supply systems, it is not a widespread practice to ensure production all the time, but the existing genetic resources have made it possible, at least potentially. (See chapter IV)

Storage. *Nal* or corn

When corn matures, it contains 18 to 20% water. For storage, it should not have over 14 to 16% water. Therefore, it is important to dry the corn for 4 to 5 months after ripening in the field before storing it. Most producers store the corn in a granary or ch'il on the plot or in the house or milpa. The granary is built on a 10 cm elevated platform for protection. It is made of wooden poles and thatched palm roof.

Storage is one of the critical phases of the milpa cycle because two worms attack the grain: *Phostephaus truncatus* or *bool* in Mayan, and *Sitophilus zeamaiz*, *pi'is* in Mayan. Some *milperos* put insecticide between layers of corn to protect them from these attacks. Others store it in plastic bottles or in metal recipients. Acosta, et.al. (1984: 52) points out that yellow corn is less attacked because of the hardness of the endosperm.

Storage of other crops

Leguminous seeds, *pepita* seed and coarse seeds are all stored in plastic bags. Beans are sometimes left in their pod and stored in rolls.

Roots and tubers are stored naturally in the soil, because if they are not taken out, they can be preserved, and can last up to five years.

Other seeds such as tomatoes, peppers, and watermelon are usually stored in small sachets that are placed on a crossbar over the fire so that the smoke that rises permanently prevents them from rotting.

Once presented the milpa system, we will define the milpa.

DIFFERENT TYPES OF CORN. PHOTO: MARIGEL CAMPOS CAPETILLO

What it has been described, is the traditional milpa cycle. As we will see in the next section, in some places of the Yucatan Peninsula that are not as stony as the north plain and the have a relative profound soil, it is found continuous milpas that do not cut and burn the vegetation, but only one time, to clear the parcel, and that continue planting year after year without rest.

GAP IN THE MILPA. PHOTO: THE NATURE CONSERVANCY

Phases of succession and agroforestry management around the mayan milpa

The Maya milpa system in its different types (continuous and traditional), as mentioned above, represents a highly complex process in its different aspects and approaches, from its analysis and interpretation to its production processes.

The milpa involves a whole "cycle" in which the continuous and traditional management of the system converges. And although this cycle represents the entire process, each stage has by itself a whole interpretation and interrelated activities that result in the high complexity of the system.

To facilitate the reading of the whole cycle, we will start with the traditional milpa, which, based on theory and praxis, involves a cycle that starts from the first 3 years in its management and production, to different "rest stages", starting from the fourth or fifth year, up to 40 and more years, until it becomes a mature forest, with all its natural and biological processes of restoration, until it reaches the climax of a mature tropical forest. (See diagram).

During this process of rest, there is a breakpoint that can range, in our days, from 10 to 15 years (sometimes less) in which a decision is made to restart the productive milpa cycle, with all the benefits of the natural recovery of the soil and ecosystem.

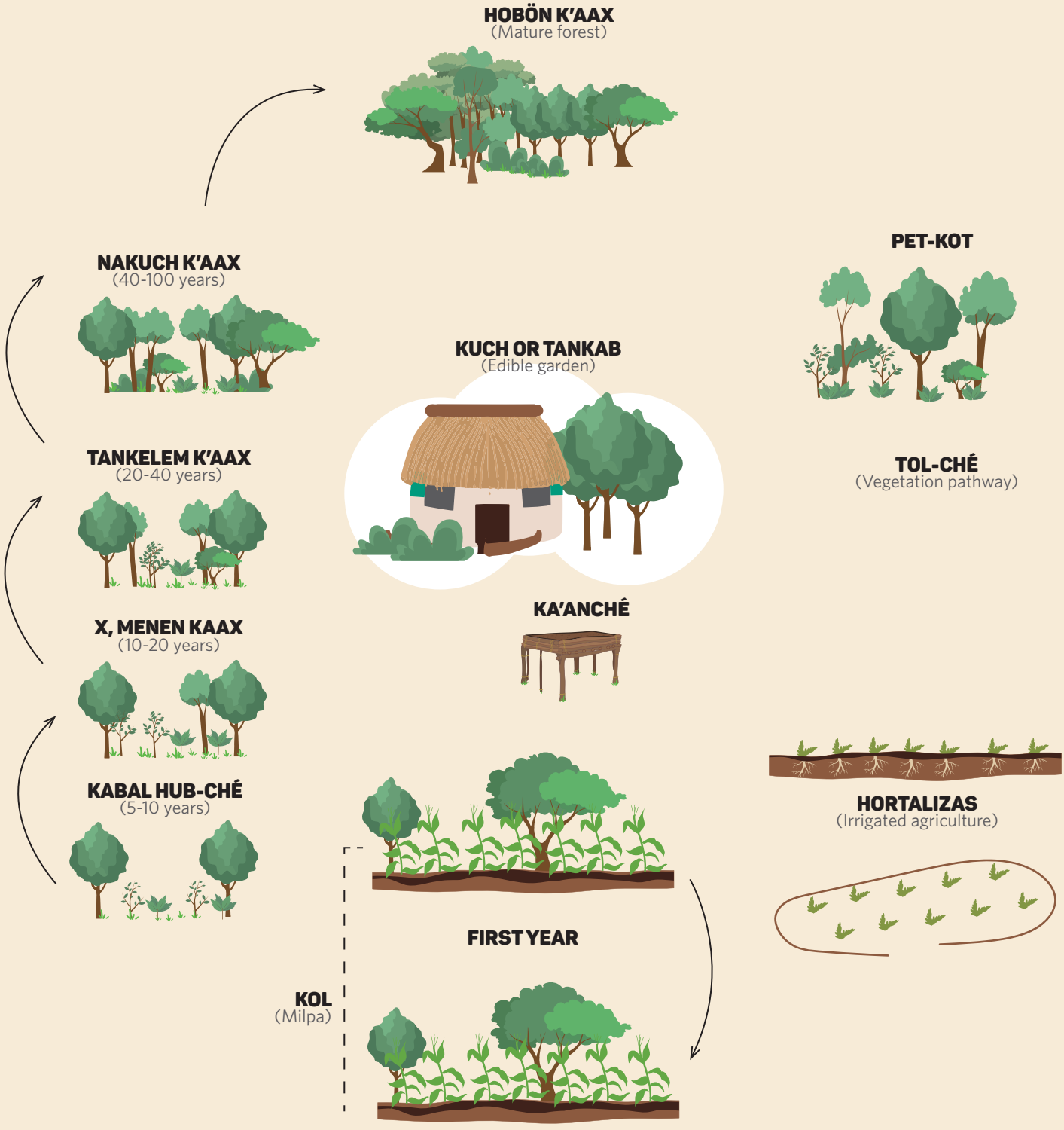
For this reason, the Maya milpa is intricate in a deep connection and holistic vision of nature and its own regeneration processes.

However, in the management of a productive milpa for the first 3 years and/or continuous milpa, without taking long periods of rest, there are also processes and stages that characterize it, as well as traditional and agroecological management actions in which the effect on the soil properties is avoided and guarantee the harvest, associating also the knowledge of the stars, such as the weather and moon phases that allow not only the production but also the traditional knowledge permanence.

Among the continuous milpa process (and in production) that involves an "annual cycle", amid the most outstanding stages are the selection of the land; the preparation and cleaning processes (slash and burn); sowing; weeding; harvesting and storage (See figure 4). After this cycle, distribution and final consumption are integrated, meaning, from the milpa to the table.

Finally, it is important to mention that in each cycle, whether of the traditional or continuous milpa, ceremonial aspects and ancestral knowledge are involved at all times, linked to protecting nature, which have been documented for years, but their totality is still unknown, due to the variability of each milpa in each community.

FIGURE 1. PHASES OF SUCCESSION AND AGROFORESTRY MANAGEMENT AROUND THE MAYAN MILPA



Find in Annex 19, Photographic illustration of the Maya Milpa Cycle

III.A.4 Definition of Today's Milpas and GIAHS Selection

III.A.4.1 Today's Milpa Definition

Today's milpas present adaptations to processes -as industrial agriculture and cattle ranching or tourism-, which have been affecting during the last 50 years (see III.C) to traditional agriculture, mainly because of the decrease in forest availability, the reduction of fallow time and the consequent decrease of fertility and increase of pests and weeds.

To redefine the milpa, we take the results of a study conducted by CRUPY[1] (Rodriguez, A. et al, 2016: 23-26) in 6 communities of Yucatan that represent different situations that we can find in the three peninsular states.

Considering the current situation of the polyculture, this study takes into account three criteria to define and typify the milpa.

1. The use of a great diversity of native Maya peninsular seeds. This characterizes the MPM as the centerpiece of the Maya identity and whose technology depends on a deep knowledge of nature, climate, topography, and soils.
2. Fields with or without rest.
   - 2.1. With rest.
     - 2.1.2. Resting time (fallow) of fields used (categories: long rest, short rest, and medium rest). Identifies the recovery margin of the field used.
   - 2.3. Continuous use (subsequently classified by plowing technique).
     - 2.2.4. Soil plowing (categories: plowing and spreading).
     - 2.2.5. Without plowing.

FOREST LANDSCAPE. PHOTO: THE NATURE CONSERVANCY

Each milpa production unit studied was assigned the three criteria. Six milpa subtypes were identified, which are grouped into two main types:

1. The continuous Maya milpa in which the soil does not rest, but is plowed
2. The traditional Maya milpa which is characterized by letting the soil rest.

The conclusion is that besides the traditional Maya milpa described in IIIA.2 and III.A.3, transformed by the decrease of forest and with reduced fallow times (Type No. 2), there are now milpas which are in continuous use (Type No.2). In these milpas there is no slashing and burning every two years, but they are still considered milpas because they manage multiple crops with the Mesoamerican triad, maize, beans, squash and the local beans "ibes".

Additionally, there is a Modernized Maya milpa, which includes the two subtypes which plow the soil (it is called milpa because producers still call it that). This type of milpa is not really considered a milpa by the referred study, nor by this proposal, because it is no longer a polyculture.

1 CRUPY is a regional center that depends on the University of Chapingo, which is the National Agrarian University of Mexico.

III.A.4.2 Continuous Milpas

These milpas are only possible in specific parts of the Peninsula called *Planadas*, near hills and micro-regions with deep and well-drained soils, (usually *luvisols* or *cambisols*) alternating with hills that briefly break the vast panorama of the Peninsular plateau.

These *planadas* make up only 10% of the total area of Yucatan and are located mainly in its southern micro-region. They are more extensive in the south-central of Campeche and north-central of Quintana Roo. This explains why the traditional milpa is more widespread in Yucatan, where *planadas* are less common.

In these *planadas* is where mechanization and plowing of the soil has progressed since 1960.[2] (See III.C)

In Maya communities with these types of soils, crops are combined in *planadas* with the traditional milpa in those portions that do not have deep soils.

III.A.4.3 The Pachpakal or Pet Pach and Planaditas

The *pachpakal* is the temporary vegetable milpa-plot. As the milpa decreases its itinerant nature, the *pachpakal* gains greater importance within the system, and becomes a permanent agricultural plot of continuous use, introducing cultivated species into the fields, especially short-cycle crops. This agricultural area is mostly geared to market production and favors the introduction of monetary income to the family, but its crops are also consumed by the *milpero* family.

The *pachpakal* vegetables are usually sown in *planaditas*; this name is given to those portions of the milpa land with more and deeper soil.

There are continuous milpas where organic materials replace agrochemicals.

III.A.4.4 The Modernized Milpa

This is a new type of technological package that has been imposed. Its key feature is that once an area has been opened to agriculture, the slash-and-burn is no longer used. The package comprises sowing a lower diversity of species, the use of improved commercial maize seed that is fertilized with an 18-46-00 NPK combination and the use of herbicides, first the 4/2 D -amino and more recently glyphosate, before sowing and during the cycles. This package is not suitable for the region because the soils are thin and permeable, and chemicals can easily filter into the soil and aquifers.

They call it milpa, but it is not, because it is a monoculture, and its management differs completely from the traditional Maya milpa.

Although the traditional milpa also uses agrochemicals, they do not use them in many processes or for a long period, and that makes a difference.

III.A.4.5 Milpas proposed for this GIAHS proposal.

In this section, we will define the map of the region that we propose as a GIAHS Area of Ich Kool: Milpa Maya of the Yucatán Peninsula in México.

We will explain the Milpa types considered in our Area; who took part in the definition of the Area the criteria that we used to define the Core and the Buffer Zone, and the aspects that were considered in doing so. We consider two subzones 1) Core Zone and 2) Buffer Zone.

2 With government programs to establish monocultures of citrus, rice, vegetable patches and maize hybrids, even Mennonite fields and pastures gained farmland to the traditional milpa in the last 40 years (Rodriguez, A. et al, 2016: 50). This is where the current soybean plantation expands despite opposition from beekeepers because their organic honey was contaminated with transgenic soybeans and could not be exported.

Milpa Types considered in the Milpa Core.

According to a study conducted by CRUPY Rodriguez A. et. Al. 2016: 23-26), that used three criteria for classifying the milpas (the use of great diversity of native Maya peninsular seeds, fields with rest, fields with continuous use), six milpa types were identified, which are grouped into two main types:

1. The traditional Maya milpa which is characterized by letting the soil rest.

2. The continuous Maya milpa in which the soil does not rest, but is plowed.

The conclusion is that besides the traditional Maya milpa described in IIIA.2 and III.A.3, transformed by the decrease of forest and with reduced fallow times (Type No. 1), there are now milpas which are in continuous use (Type No.2). In these milpas there is no slashing and burning every two years, but they are still considered milpas because they manage multiple crops with the Mesoamerican triad, maize, beans, squash and the local beans “ibes”.

Additionally, there is a Modernized Maya milpa, which includes the two subtypes which plow the soil (it is called milpa because producers still call it that). This type of milpa is not really considered a milpa by the referred study, nor by this proposal, because it is no longer a polyculture.

PENINSULAR MAYAN MILPA OF MEXICO: TYPES AND SUBTYPES

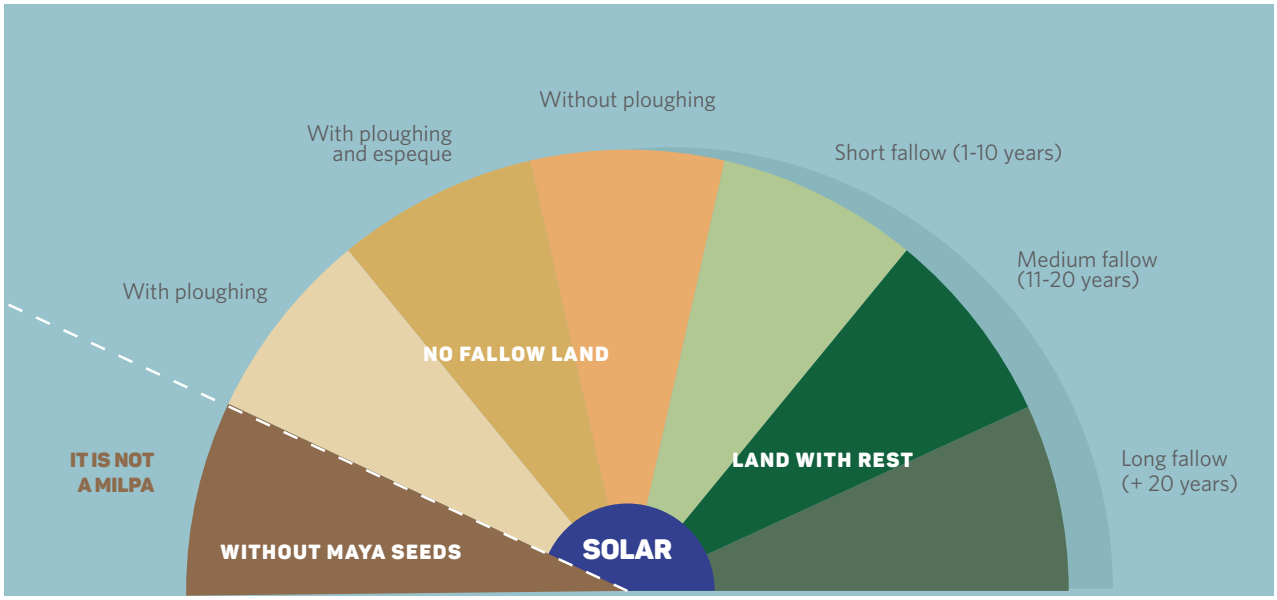


FIGURE 2. MILPAS CLASSIFICATION OF THE YUCATAN PENINSULA IN MEXICO.

TECHNIFIED MAYA MILPA CONTINUOUS MAYA MILPA TRADITIONAL MAYA MILPA

Distribution of the two types of milpa in the Yucatán Peninsula.

The traditional milpa is distributed throughout the entire core zone and the buffer zone. The continuous milpa is only in a portion of the core zone that we have delimited with red, with the greatest presence in Campeche, then in Quintana Roo and finally in Yucatan. However, in order to precisely define its distribution, a census would be necessary, which with the continuous milpa would yield relatively stable data, while for the traditional milpa we would have dynamic data, valid only at the time of the census, because it is a wandering milpa that changes location every year or every two years.

However, it is emphasized that there are areas where the milpa is no longer cultivated because of the expansion of cattle ranching and/or commercial agriculture, and in others, the activity has been abandoned for different reasons, including labor migration.

For this reason, our GIAHS proposal does not cover the entire peninsula, but we have delimited it, defining a core zone, surrounded by a Buffer Zone.

DISTRIBUTION OF THE TWO TYPES OF MILPA

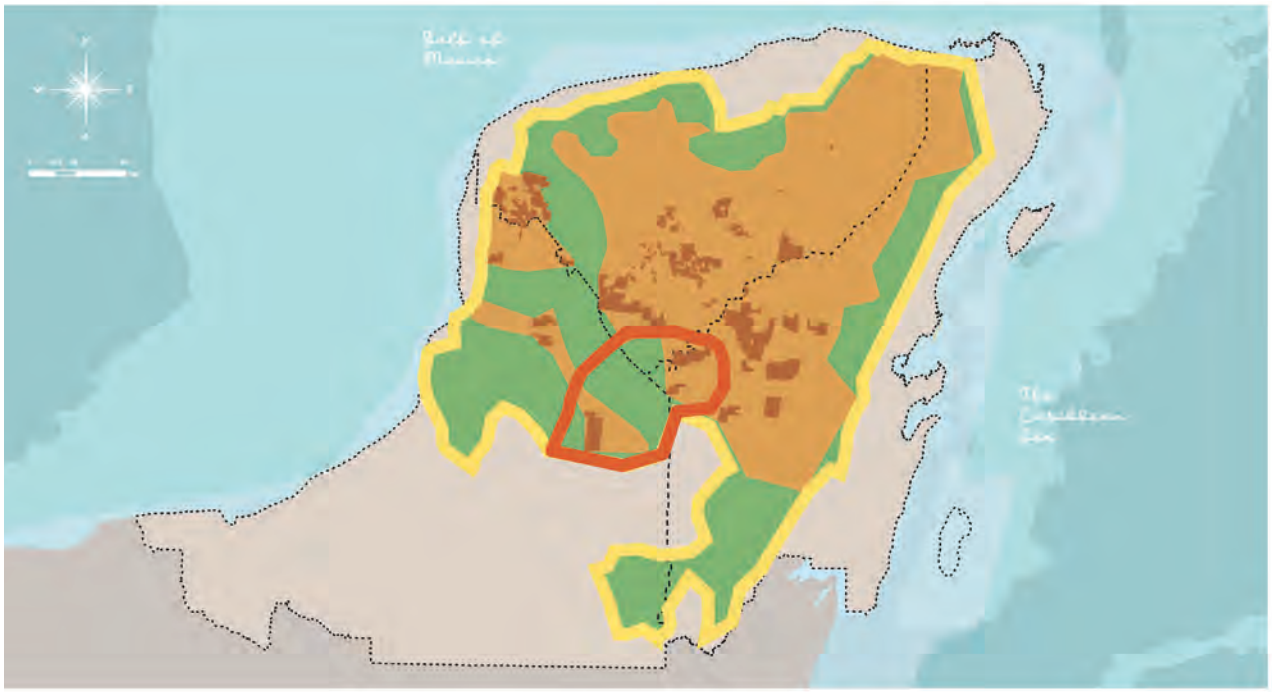


FIGURE 3. ILLUSTRATION OF THE PREDOMINANT DISTRIBUTION OF THE TWO TYPES OF MILPA IN THE PENINSULA.

Criteria used to define the GIAHS core area.

The reasons for defining the GIAHS Zone are explained below.

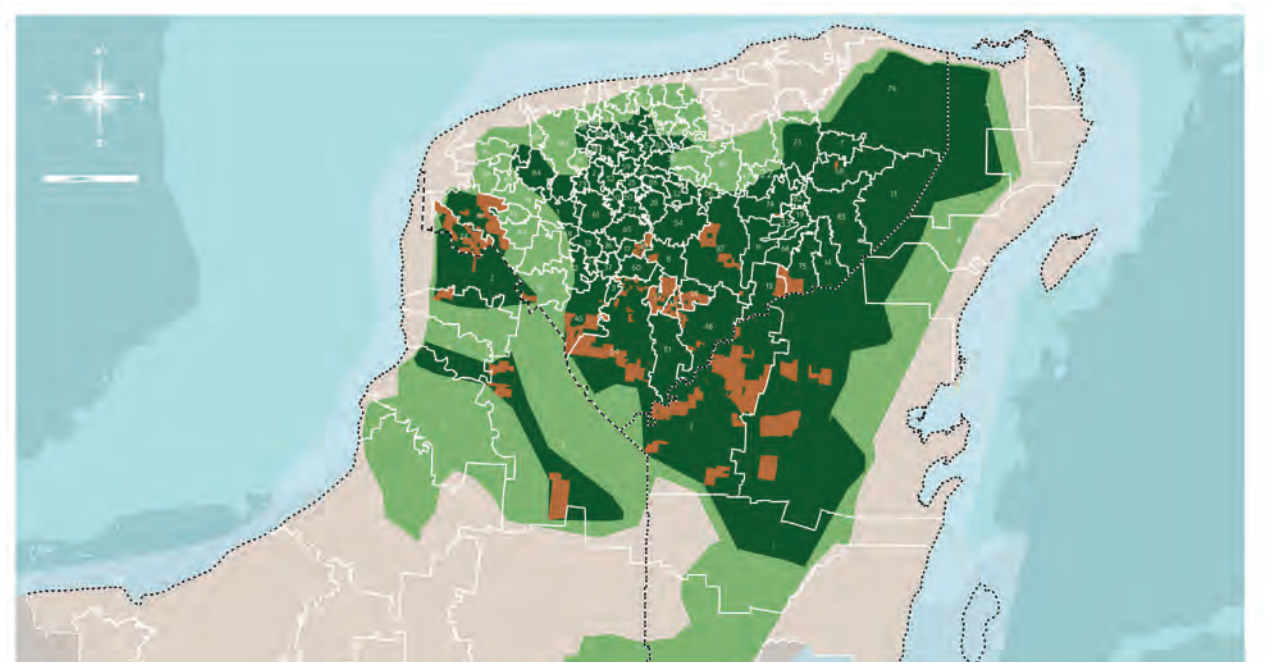
Core Zone

The core zone is the one in which the milpa communities have grown together with their germplasm in the last 3,000 years and that provide a high resilience to climate changes, maintaining a habitat for wildlife in succession processes with the highest biodiversity (on which they depend), in good conditions, besides maintaining soil fertility, -via detritus derived from leaf litter-, favoring the environmental services of support and regulation of microclimate and water storage, among other benefits. Therefore, it is important to merge these services through the preservation of ancestral practices and germplasm. It also includes those communities and ejidos where studies have been conducted on the milpa, and workshops where participatory processes were carried out for the GIAHS proposal, as well as the culture associated with the germplasm conservation (language, food, knowledge of the bush, cosmovision and rituals).

Buffer Zone, surrounding Area of the Core Zone

Although not included in the GIAHS proposal, it is important to define the characteristics of the surrounding zone of the core area: the Buffer Zone, in order to understand the agroecological and socio-cultural context that accompanies it. Buffer Zone Includes those areas where traditional milpa production practices are maintained, but with the risk of losing the agrobiodiversity of ancestral germplasm, affecting fundamental provisioning services. There is a strong demand for market oriented agricultural activities that generate adverse effects on the environment, altering the quality of wildlife habitat, decreasing biodiversity and the germplasm bank, thus diminishing environmental support services, hence the importance of stabilizing them by improving habit.

YOUNG WOMAN MILPERA. PHOTO: MARIGEL CAMPOS CAPETILLO



MAP 2. MUNICIPALITIES INCLUDED IN THE CORE AND BUFFER ZONE OF THE PROPOSAL, WHICH ARE LISTED IN ANNEX 18.

SYMBOLOGY

- CORE ZONE
- BUFFER ZONE
- LOCAL SURVEY OF GIAHS IN *EJIDOS*

SOURCES:
Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Authors that participated in the delimitation of the GIAHS ZONE.

Secretary of the Sustainable Development of the Government of the State of Yucatan
Secretary of Environment of the Government of the State of Quintana Roo
Secretary of Environment, Biodiversity, and Climate Change of the Government of the State of Campeche
Silvia Terán. Master in Social Anthropology. Researcher of the Department of Cultural Heritage of the Ministry of Culture of Yucatan.
Sebastién Proust. National Coordinator of the UNDP Small Grants Program
Dr. Eduardo Batllori Sampedro. Researcher of the Center for Research and Advanced Studies of the IPN Merida Unit.

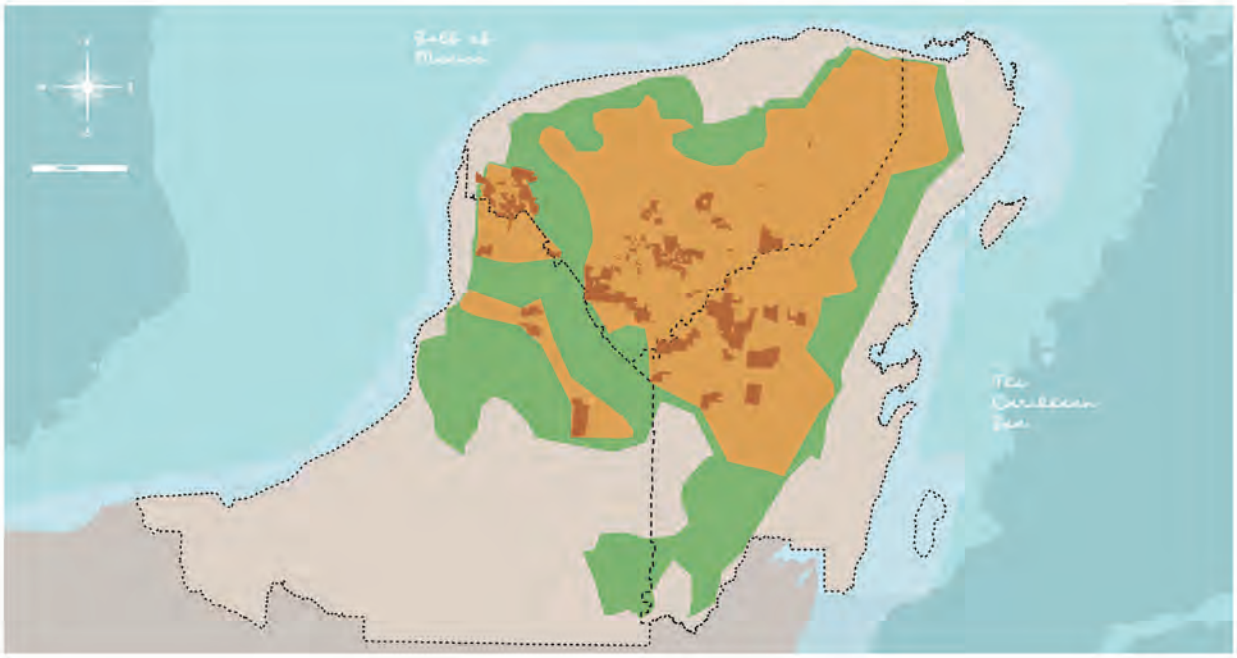
Sources

For the definition of the GIAHS Zone, a geographic information system was integrated with the cartography derived from the following projects.

1. Javier Becerril García (2014). The Social Accounting Matrix of the State Reserve “Biocultural del Puuc”. Mexico Alliance for the Reduction of Emissions from Deforestation and Degradation.

2. United States Agency for International Development (USAID) Mexico Reducing Emissions from Deforestation and Degradation (M-REDD+) Project, The Nature Conservancy, Rainforest Alliance, Woods Hole Research Center, Espacios Naturales y Desarrollo Sustentable AC. 2016. Authors: Rodríguez Canto, A.; González Moctezuma, P.; Flores Torres, J.; Nava Montero, R.; Dzib Aguilar, L A.; Pérez Pérez, J. R.; Thüerbeck, N. and González Iturbe, J. A. Milpas de las comunidades mayas y dinámica de uso del suelo en la Península de Yucatán. Centro Regional Universitario Península de Yucatán of the Universidad Autónoma Chapingo. Merida Yucatan. 436 pp.

3. Surveys of the milpa maya system for GIAHS proposal. UNDP, 2018.

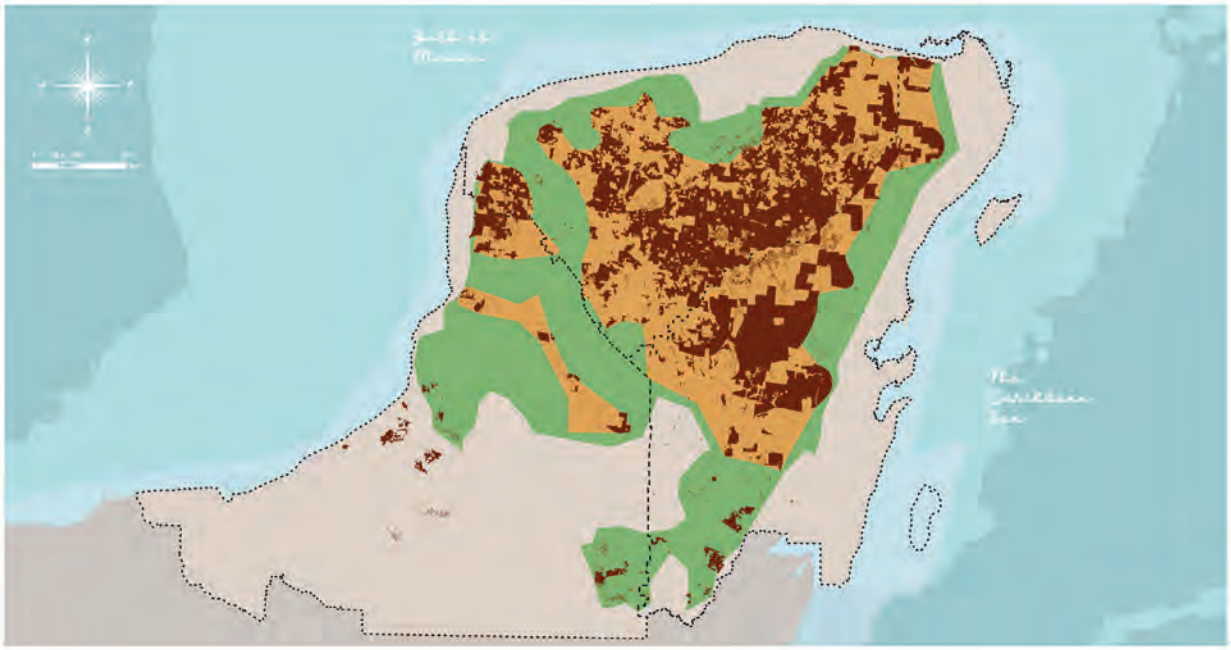


MAP 3. COMPARATIVE MAP OF THE GIAHS REGIONALIZATION AND THE EJIDOS LINKED TO THE SURVEY LOCALITITES

CORE ZONE
BUFFER ZONE
LOCAL SURVEY OF GIAHS IN EJIDOS

4. Ellis, E.A., Romero Montero, A. & Hernández Gómez, I.U. (2015). Assessing and mapping the determinants of deforestation in the Yucatan Peninsula. United States Agency for International Development (USAID), The Nature Conservancy (TNC), Mexico REDD+ Alliance, Mexico City.

CORN. PHOTO: THE NATURE CONSERVANCY



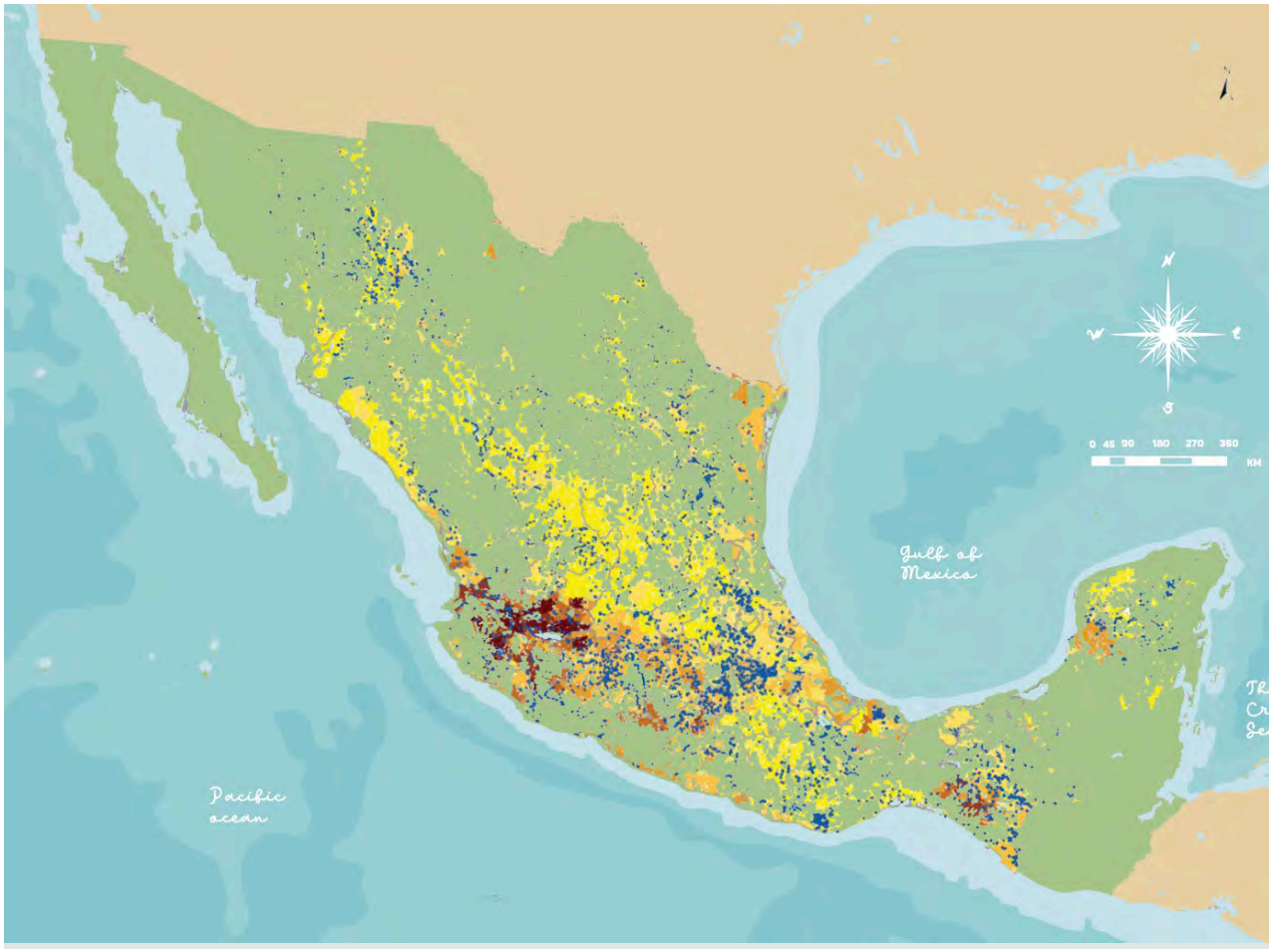
MAP 4. DISTRIBUTION OF SUBSISTENCE AGRICULTURE IN THE GIAHS REGIONALIZATION IN RELATION TO THE DEFORESTED AREAS (TNC).

NUMBER OF MILPEROS PER COMMUNITY THAT AGREE WITH THE PROPOSAL

State	Municipalities	Communities	*Milperos* that agree with the proposal
Yucatán	Yaxcaba	Yaxcabá	20
		Huechenbalám	25
		Canakóm	60
		Plan Agrario	7
		San Marcos	15
		San Pedro	13
	Tixcacalcupul	Poop	32
		San José	17
		Mahas	16
		Ekpedz	19
	Halachó	Ejido de San Antonio Sihó	66
		Halachó	22
		San Mateo	2
		Cepeda	1
		Cuch Holoch	1
		Ejido San Roman	40
	Maxcanú	Maxcanú	12
	Tixmehuac	Sabacché	5
		Kimbilá	17
		Sisbic	33
		Tixméhuac	2
		Dzutóh	1
	Tahdziu	Tahdziú	2
		Timul	8
	Peto	Kambul	22
		Xoy	11
	Chacsinkin	Xbox	2
		Chacsinkín	28
	Mayapan	Mayapán	52
	Cantamayec	Cholul	7
	Temozon	Ekbalam	25
Subtotal			583

State	Municipalities	Communities	*Milperos* that agree with the proposal
Quintana Roo	F. Carrillo puerto	Dzulá	1
	Jose maria morelos	José María Morelos	1
		Puerto Arturo	14
		Plan de la Noria Poniente	15
		Ignacio M. Altamirano 2	12
		General Francisco Villa	12
		San Felipe Primero	13
		Tabasco	15
		San Diego	4
		San Cristobal	11
		San Antonio Tuk	23
		Kantemó	1
		Adolfo López Mateos	2
		Dziuché	2
		Kancabchén	1
		Emiliano Zapata	13
Subtotal			140
Campeche	Hopelchén	San Juan Bautista Sahcabchén	11
		Cancabchén	34
		Ich ek	8
Subtotal			53
Total	**14**	**30**	776

5. Supplementary materials, methods, figures and tables for Bellon Mauricio, Mastretta-Yanes Alicia, Ponce Alejandro, Ortiz- Santamaria Daniel, Oliveros-Galindo Oswaldo, Perales Hugo, Acevedo Francisca, Sarukhan Jose. Evolutionary and food supply implications of ongoing maize domestication by Mexican campesinos. Proceedings of the Royal Society B. Doi 10.1098/rspb. 29.aug.2018.



MAP 5. EVOLUTION AND FOOD SUPPLY CONSEQUENCES OF THE CONTINUOUS DOMESTICATION OF MAIZE BY MEXICAN MILPEROS.

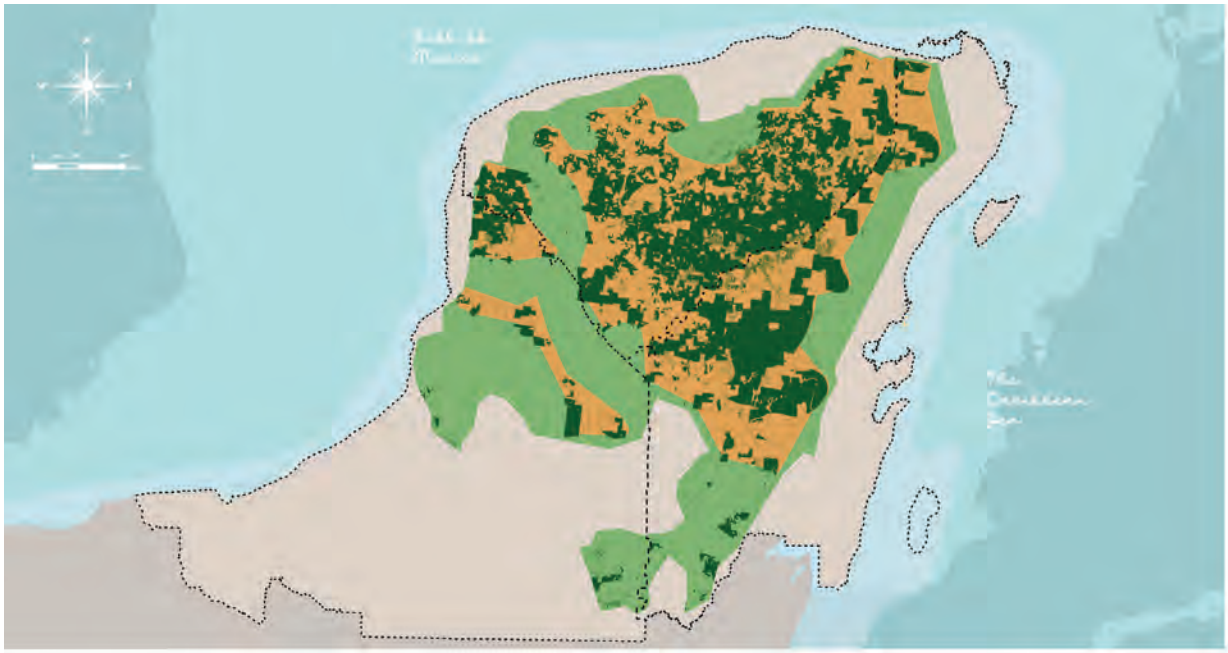
SYMBOLOGY

- NATIVE MAIZE SAMPLING

RAINFED MAIZE YIELD 2010 (TON/HA)

0 TO 1 · 1 TO 2 · 2 TO 3 · 3 TO 4 · 4 TO 5 · 5 TO 6 · 6 TO >

6. Regionalization Map of the Milpero Peninsular System. 2019. Prepared by: Patricia Ortega, Mauricio Galeana, Laura Pérez. CENTROGEO



MAP 6. GIAHS REGIONALIZATION WITH AGRICULTURE PRESENCE, OF WHICH 80% CAN BE ASSOCIATED TO MILPA. CENTROGEO

III.A.5 The Milpa Core and Buffer Zone Proposed GIAHS Zone

III.A.5.1 Distribution of the proposed GIAHS ZONE in the three Mexican peninsular states

Zone	Campeche (ha)	Yucatan (ha)	Quintana Roo (ha)	Peninsula(ha)
Core zone	378,556	2,439,897	1,580,270	4,398,722.70
Buffer zone	1,406,929	826,440	1,075,455	3,308,824
Remaining Mexican Yucatan peninsular Territory*	3,977,957	911,358	1,825,197	6,714,512
Total ha.	5,763,442	4,177,695	4,480,922	14,422,059
% portion of core zone in relation to the entire peninsula	**40%**	**29%**	**31%**	**100%**

The above table refers to the total surface of each state of the Peninsula divided by the two zones proposed as GIAHS: 1) Core zone and 2) Buffer zone; and by the remaining territory of the Yucatan Peninsula of Mexico, which, as previously established, is the zone that has largely lost its culture and traditional practices of food production and therefore is not included as GIAHS.

It should also be noted that the extensions reflected in the regionalization table of our proposal for the mayan milpa were determined through the analysis of the various attributes mentioned above, among which are the areas of aptitude and production of milpa, cultivated species and areas with historical and cultural relevance associated with traditional knowledge. It is worth mentioning that the figures in this table are not associated with the amount of input production in the milpa, producing families or producers; figure 22 “Composition of annual non-monetary income by percentage, by location and Composition of annual monetary income by percentage, by location”, refers more precisely to this topic.

CORNCOB. PHOTO: THE NATURE CONSERVANCY

Part B. Contemporary Relevance of the Peninsular Maya System

Having described the milpa system in the Yucatan Peninsula and the region and milpa types we are proposing as GIAHS area, now we will highlight those features that we consider of contemporary relevance and that are important for considering this system as a GIAHS candidate.

III.B.1 The Milpa is a System Related to Food and Livelihood Security, and Contributes to the Maintenance of Global Agricultural Wealth

The domesticated-plant genetic resources have played an important role in the high adaptability of the system, to the soil and climate limitations, and are part of the world heritage. The peninsular Maya milpa system has generated genetic material with high adaptability to drought conditions and pests; this is invaluable when facing current climate changes. These species include yellow corn and other short-cycle corn variants.

These seeds must be protected and enhanced for us, and for the benefit of future generations.

The milpa provides high-quality nutrition because the three species that comprise the core of the polyculture – corn, beans, and squash – contain all the nutrients the human body requires: carbohydrates, proteins, fats, vitamins and minerals.

The conservation of the milpa system in the Yucatan Peninsula, promotes access to healthy, nutritious and sufficient food for the poor sectors of the region, such as *milperos* and their families, a fact of contemporary relevance, considering the heath problems that not only the Maya population presents today but also the world population in relation to obesity, diabetes and malnutrition.

Industrial agricultural systems displace the forest and destroy biodiversity by settling permanently in one location and depending on fossil energy. The milpa maintains vegetation stability because it integrates the forest into the system by relying solely on solar energy as a biomass starter, instead of fossil energy. Due to the critical advance of global deforestation, the Maya Milpa model makes an even more important contribution to the planet, a fact of contemporary relevance.

III.B.2 Milpa is Agrobiodiversity, Culture, Values Systems and Social Organization

The forests preserved by the Milpa system, even though they are mostly deciduous and have been losing an acceptable stabilization, contribute significantly to CO_2 sequestration. The Milpa area is a conglomerate of mosaics with volumes between 37.98 – 41.35mts and 41.35 – 46.72 ton/ha. According to data generated in the Puuc Reserve, one portion of the milpa region – 215,000 tons of carbon are kept – creating a carbon density of 119.5 tons per ha. (See IV.2).

This environmental service can be seen as a global contribution and is considerable in the mitigation of climate change, an aspect of contemporary relevance, definitively.

It should be noted that the Maya biocultural system that extends from the state of Campeche to Quintana Roo, including Yucatan, contains the most extensive milpa area in the country. It is inhabited by the peninsular Maya people who speak Yucatec Maya, the second most important indigenous language of Mexico, after the Nahuatl language of central Mexico. The Maya milpa is in the second-largest rainforest of the American continent, after the Amazon.

If we consider that thanks to milpa technology, this forest has been maintained despite the advance of commercial agricultural systems, the conservation of this forest is a global contribution of the Maya

GUARDIANES DE LA SEMILLAS. PHOTO: MARIGEL CAMPOS CAPETILLO

milpa system and its culture and we consider it of contemporary relevance.

The system presents high climatic resilience, considering that it is in an area with frequent natural disasters such as hurricanes and forest fires. Some fires result from regulated agricultural burns that are part of the agricultural process and, they can be seen as a strategy to avoid great forest fires that occur naturally after hurricanes and to protect biodiversity. (See II.A.3.3 and IV.3)

There are important ancestral practices such as firebreaks (See IV.3), seed selection and information management regarding annual cycles and seasonal fluctuations which also contribute significantly to risk management. These practices are of contemporary relevance because it is a phenomenon that has been increasing because of the climatic change, and they help to conserve the agrobiodiversity.

The milpa not only produces food, it also produces identity and culture, which reinforces the global relevance of the polyculture. In the Popol Vuh – the Book of Creation considered the Maya Bible-, for example, the description of the origin of the world is analogous to the clearing of forest for the milpa, and it is also stated that the material used by the gods to make the first men, was white corn and yellow corn. The existence of the peninsular Maya culture depends on the Milpa and vice versa, therefore this characteristic of the milpa system is of contemporary relevance. *Cultures, values systems, and social organization.*

The sustainability of the milpa is rooted in philosophy and spirituality. The fundamental premise of the system is that the forest does not belong to the human being, but to a superior power to that of humankind. Therefore, the latter must ask for permission and subsequently thank for its use, which must be moderate, because man is not the owner. This ethical axiom has been key to the sustainability of the system.

Respect is reflected in a harmonious treatment and moderate consumption of nature; this is the key to sustainability and is an ethical example that

A PHOTO REPRESENTING THE SPIRITUALITY OF THE MAYA MILPA. PHOTO: VALENTINA ÁLVAREZ BORGES

should have a global impact towards generating new paradigms of truly sustainable development.

This is an important feature of contemporary relevance and refers to the issue of *Cultures, values systems and social organization.*

The Peninsular Maya Milpa is a system that has maintained the forests of the Yucatan Peninsula, through the slash-and-burn technology, for 3000 years because it depends on them, and along with the forest, it has also preserved and developed its culture, since it is organically linked to natural resources (food, rituals, material culture, cosmology, philosophy, literature).

Forest management has led to interesting dynamic landscapes shaped by the different phases of plant succession and animal life. Besides these landscapes, we find in the Yucatec Forest, a series of karstic underground landscapes such as caves, grottoes and *cenotes* that have been important as water sources, and are now being exploited for tourism and ecotourism purposes.

We consider this of contemporary relevance and are convinced that protecting the Maya milpa is synonymous with protecting the biocultural heritage of the Yucatan Peninsula.

III. B.3 Background of UNDFF (2018-2021)

The UN named 2014 as the Year of Family Farming. It was made to highlight its global importance for producing 80% of the planet's food and for its contribution to the preservation of traditional foods that favor a balanced diet, while safeguarding global agricultural and aquaculture biodiversity, domesticated plant genetic resources and culture and community organizations linked to the territories, thus providing a unique opportunity to ensure food security, improve livelihoods, manage natural resources while protecting the environment and achieve sustainable development, especially in rural areas.

On this occasion, FAO proposed the following definition of family farming: "Family farming is a way of organizing agricultural and forestry production, as well as fishing, pastoralism, and aquaculture, which is managed and directed by a family and mostly depends on family labor, both female and male".

Subsequently, faced with growing pressure to provide sufficient, affordable, and nutritious food to a growing population, and to address climate change, natural resource degradation, and increasing rural-urban inequalities, the important role played by family farmers in providing most of the world's food, being the main investors in agriculture and making up the backbone of the rural economic structure was considered. With these arguments, the United Nations Decade of Family Farming (2019-2028) and an Action Plan were approved, suggesting strategies and actions that could favor its development and global strengthening in order to contribute to a better management of the environmental management in the global problems that afflict.

The UNDFF Action Plan is aligned with the SDGs set out in the 2030 Agenda and aims to speed up collective, coherent, and comprehensive action to support family farmers as key agents of sustainable development.

The Peninsular Maya Milpa and Family Agriculture

In Section III. A. 3.8 of this text we state that one characteristic of the milpa system is that the productive unit is the family: "The family is the economic unit that performs the different chores in the milpa, as well as its multiple productive activities, and this is a strength of the system; the biological link creates a cell of great solidarity, cohesion, and of social and economic adaptability to any crisis (Canul, 2016)". For the same reason, milpa production is part of family farming[1]. If we analyze the 7 Pillars proposed to be promoted in the decade 2018-2028, we see that, just as the milpa system contributes to the achievement of the goals of the 2030 Agenda, it also contributes to achieving the commitments made by A UNDFF.

1. **Create a policy environment favorable to family farming.**

To develop and strengthen family farming-friendly policies, investments, and institutional frameworks at local, national, and international levels based on inclusive and effective governance and timely and geographically relevant data. To ensure sustained political commitment and adequate resources from public and private actors. To create and strengthen international, national, and local cooperation and partnerships to promote the rights and multifunctional role of family farming.

The very process of promoting GIAHS certification has involved the generation of an enabling environment for family farming among various institutions, civil society organizations, and academic and scientific institutions. Certainly, it has not been promoted with this approach, but it would be important to give it this perspective, not only to raise

1 One of the differences with family *milperos* in Europe or the US is that family farming has historically been governed by a logic of self-consumption, although it has always produced surpluses to pay taxes and exchange them for other products not produced by the family. However, the increasing monetization and commercialization of the economy has been changing the rationality of the *milpero* system and now, the activities that generate money are the most important, and corn is produced for self-consumption. This phenomenon is bringing *milperos* closer to western family economies.

awareness of the importance of family farming but also to encourage family farming in the Peninsula, as a development alternative. The different sectors should realize the strategic importance of this area and achieving GIAHS certification could be a means to this end. Achieving certification would be an important step towards strengthening international, national, and local cooperation to promote the rights and multifunctional role of family farming.

2. **Supporting young people to ensure family sustainability.**

To ensure generational sustainability of family farming by enabling young people's access to land, other natural resources, information, education, infrastructure, and financial services, markets, and policy-making processes related to agriculture. Leveraging the intergenerational transfer of tangible and non-tangible agricultural assets, encourage young *milperos* to interconnect indigenous traditional knowledge with innovative ideas to become agents of inclusive rural development.

This pillar is strategic for the conservation and development of the dynamic Maya milpa plan since one challenge facing the system is precisely the generation gap that has opened up between parents and children. We believe children may be interested in working with their parents in the system only if the system is innovated through training, education, financial resources, if they have access to markets and the system brings in what is necessary to live well. The system is fully aligned with this policy.

THREE DIFFERENT GENERATIONS PREPARE THE ALTAR TO OFFER SAKA' AFTER THE SOWING, CHACSINKÍN, 2019. (PHOTO TAKEN FROM THE BOOK "NUESTROS SEMILLAS, NUESTRAS MILPAS, NUESTROS PUEBLOS". PHOTO: GUARDIANES DE LAS SEMILLAS DEL SUR DE YUCATÁN BY MARGARITA ROSALES GONZÁLEZ

A SEED GUARDIAN IN THE MILPA. PHOTO: ALEJANDRO DIAZ SAN VICENTE

3. **Promote gender equity and the leadership role of women.**

To support effective instruments and measures for the achievement of women's rights and gender equality in food and agricultural production. Promote gender equality through the strengthening of women's organizations, to promote self-empowerment, the process of self-empowerment and the autonomy and independence of women, to increase access to and control of productive and financial resources, especially land, as well as access to information, social protection policies, markets, employment opportunities, education, appropriate extension services, gender-sensitive technology and full participation in political processes.

Women who are part of milpa family farming have always been involved in supporting the multiple activities of the milpa (folding, burning, harvesting) but above all in seed selection, particularly regarding culinary aspects. They have played a central role in the forging of domesticated phytogenetic resources. They have been key actors of the plots because of them depends mainly on the care of the plants and animals of the plot. In recent times, they have focused on the breeding of melipona bees and the products derived from their honey, and the cultivation of vegetables for sale. A very important activity is embroidery[2]. However, they are not recognized, and are subjected to violence by their husbands and/or fathers, mainly because of alcoholism combined with the patriarchal structure that still prevails in many Maya communities, and often prefer to leave their homes and towns to work for a salary, to earn money and autonomy. Therefore, the strengthening of family farming, with all the advantages that it entails, requires the promotion of gender equity and women's leadership as proposed in this pillar and the Action Plan for Dynamic Conservation outlined in this proposal

2 It is important to understand that embroidery was elaborated on woven fabrics and with cotton threads dyed with natural plants, so it came from family farming. It was in the 19th century when industrial fabrics from England via Belize began to be used, that embroidery began to be separated from milpa agriculture. However, the activity is still carried out within the milpera families and under the rationality of the economy of the milpera family agriculture.

.**Strengthen rural producer organizations and their capacity to generate knowledge, represent their members and provide inclusive services across the urban-rural continuum.**

Strengthened family farmer organizations are more able to raise awareness and influence policy-making processes to ensure more responsible, inclusive, participatory, and representative decision-making processes at all levels, as well as improved access to information and knowledge (SDG 16) and inclusive multi-stakeholder partnerships to enhance capacity development (SDG 17) with a particular gender aspect in relation to women's organizing (SDG 5).

Several organizations have emerged among Maya *milperos* and also among women, but it is important to empower their action so that they grow in their capacity to decide, to strengthen themselves, to connect, to educate themselves, to innovate, to influence, to establish alliances to improve their conditions and with this, to contribute exponentially to the improvement of their biocultural rural environment and of the society and territory of which they are part, which is the Yucatan Peninsula with its three states: Campeche, Yucatan and Quintana Roo. The milpa family farming has organizations that can help to promote this UNDFF Profile.

4. **Improve socioeconomic inclusion, resilience and well-being.**

Evidence shows that by focusing policies and interventions on family farmers, immediate effects are visible on several interconnected SDG targets, in particular: reducing hunger, improving nutrition and reducing poverty (SDGs 1 and 2), gender equality and reducing inequalities (SDGs 5 and 11), increasing the volume and sustainability of production and consumption (SDG 12), resilience of communities to climate change and shocks (SDG 13), improving natural resource management (SDG 14-15) and increasing investment in agriculture (IF), leading to rapid and lasting economic growth (SDG 8). For this reason, the SDGs recognize the critical role of small-scale food producers, especially women and youth, and advocate for their access to land and other productive resources to reduce poverty and improve their productivity and incomes. Therefore, national strategies aimed at eradicating poverty and hunger should take a focus on family farming, leading to integrated approaches at national and local levels.

Including

youth and women

is indispensable to the idea that peninsular Maya *milperos* can boost their family businesses

Including youth and women is indispensable to the idea that peninsular Maya *milperos* can boost their family businesses to eradicate poverty, reduce hunger, improve nutrition, increase production and consumption through increased investments that lead to rapid and sustainable economic growth. Unfortunately, official national and state agricultural institutions have not been clear about the important impact of these inclusion policies on the development of agriculture and related activities. However, we believe that both the change of mentality that is occurring in Maya communities among women and youth, as well as the needs faced by families, are conditions that make it possible to promote national strategies. In Yucatan, the current Secretary

of Sustainable Development, which promotes this initiative at the Peninsular level, is headed by a woman and we believe that this has a positive influence on the promotion of this pillar of the UNDFF.

5. **Promoting sustainability of food systems resilient to climate change.**

This pillar provides the opportunity to simultaneously address the affects of climate change (SDG 13), foster sustainability of food systems (SDGs 2 and 12), enhance sustainability in the management and use of terrestrial and aquatic ecosystems (SDGs 14 and 15), with implications for all three dimensions of sustainability. As in the previous pillars, it is crucial that enabling conditions are in place for family farmers to effectively fulfill their role as key change agents.

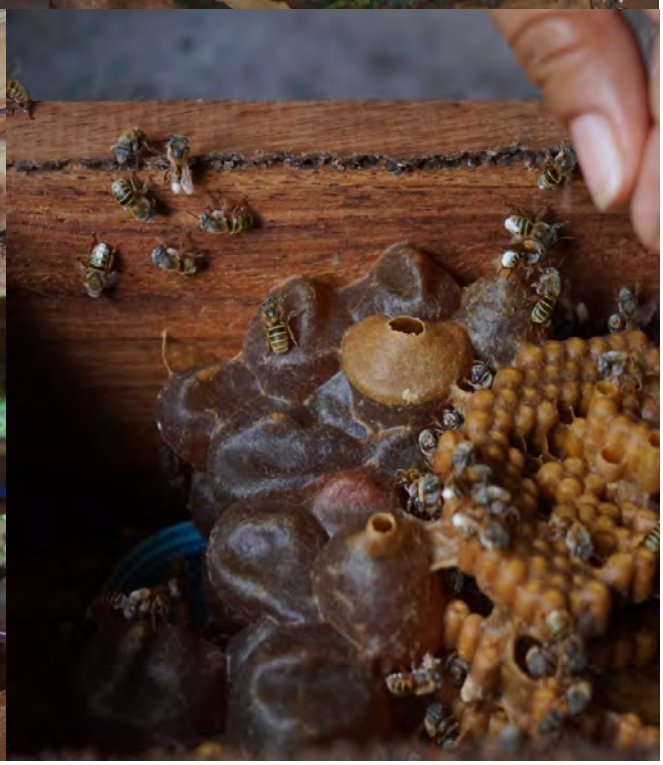
The technology of the peninsular Maya milpa system, practiced for millennia by Maya *milperos*, is part of a strategy designed to respond to a condition of high ecological uncertainty caused by the great randomness of the rainfall regime, by poor, thin, stony, and calcimorphic soils, in the framework of the warm humid forest of the Peninsula characterized by the significant presence of predators, pests and diseases. This condition has favored a technology based on domesticated phytogenetic resources, in permanent adaptation to drought, hurricanes, floods and fires, an important genetic base for the development of variants capable of facing the effects of climate change. The milpa has also been distinguished itself for having generated species that make up a diet (formed by the Mesoamerican triad corn-beans-squash) that covers all the nutritional requirements of the human body and that, although it has been lost due to the introduction of junk food, it can be recovered if adequate policies are promoted to raise awareness, value, and renew the good nutrition.

6. **Strengthen the multidimensionality that contributes to territorial development and food systems that safeguard biodiversity, the environment and culture.**

By working in this pillar, countries can promote integrated and sustainable territorial planning, addressing the needs of urban and rural populations while sustainably managing natural resources and ecosystems. This pillar allows integrated approaches to environmental targets of (SDGs 2, 14 and 15) sustainability and resilience of rural and urban settlements (SDG 11), respect and promotion of cultural heritage and traditional knowledge (SDG 12). Harnessing the traditional knowledge of family farmers and the innovation produced by them, indigenous peoples and their communities, along with the availability of innovation and technology, would further strengthen the sustainability and resilience of rural and urban settlements. With the right incentives and actions focused on rural infrastructure and market opportunities, there would be a visible impact on food availability and variety (SDG 2), as well as employment and economic opportunities for rural communities (SDG 3).

A characteristic of the milpa system, considered one of its most important strengths, is that it has been multidimensional since its origins. The milpa is composed of multiple agricultural activities (milpa, vegetables, orchards); cattle ranching (animal husbandry, meliponiculture, beekeeping, backyard livestock) forestry (collection of timber plants, medicinal, lime processing, handicrafts and wage labor). At present, due to the need for monetary income, activities other than milpa, have been gaining importance and strength because they produce interchangeable goods such as vegetables, fruits, timber trees, medicinal plants, gastronomy, embroidery, fabrics, pottery, hammocks, wood carvings, tourist services, etc. Many of these products are sold in the cities near the towns, but also in distant markets. The increasing entry into the markets has been incorporating women and young people into the family milpa economy and integrating rural and urban areas and technical innovations in various activities to traditional activities. For of all these reasons, the peninsular Maya milpa can contribute to the promotion of this important pillar of the UNDFF Action Plan.

The peninsular Maya Milpa and the Sustainable Development Goals: 2030 Agenda (see annex 20)



JULIA DANIELA KU TZUC, MELIPONICULTURIST IN MANÍ, YUCATÁN. PHOTOS: CLAUDIA NOVELO ALPUCHE

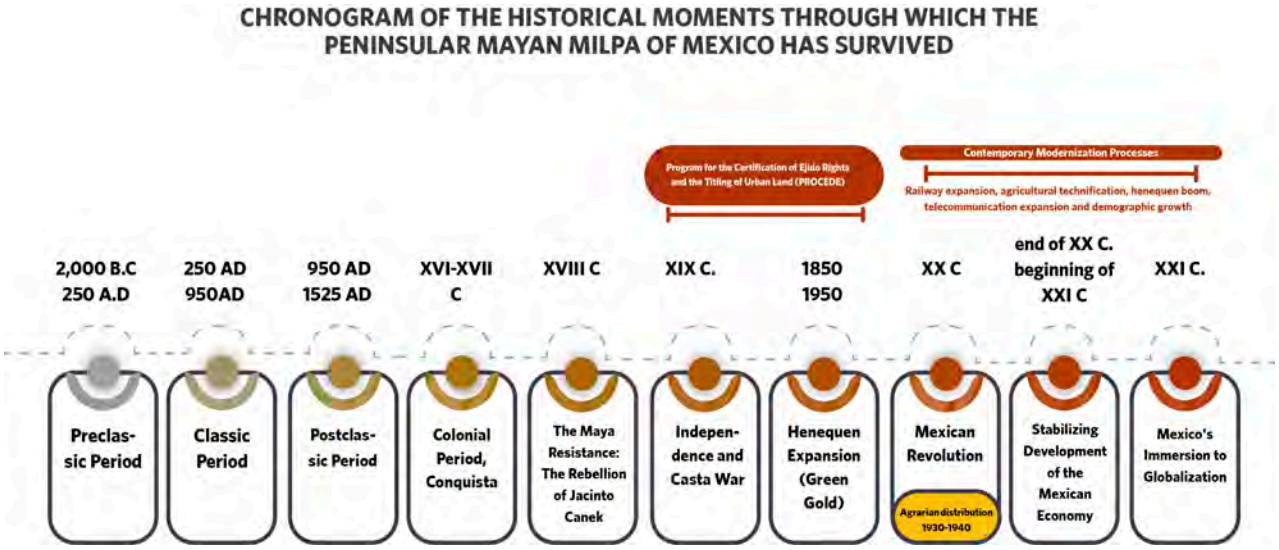
III.B.4 The peninsular Maya Milpa and the Sustainable Development Goals: 2030 Agenda (It has been relocated to annex 20)

Part C. Historical Relevance

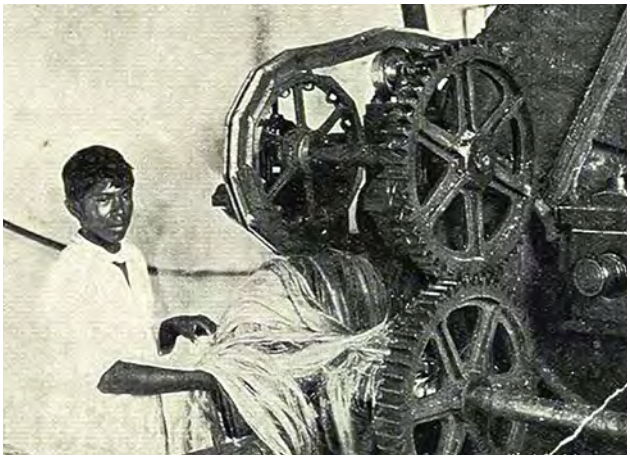
III.C.1 Mesoamerican Agricultural Strategy: The Origin of Milpa Polyculture and of the Productive Diversity of the Milpa System

It is important to understand the basis and origin of Mesoamerican productive strategy, especially with the Maya milpa, because it still exists today.

The peninsular Maya milpa is part of Mesoamerica, as we mentioned before, and is one of the Cultural Areas that has flourished in north America since ancient times.



FIRST CONTACT OF THE CONQUISTADORS WITH THE YUCATAN. ILLUSTRATION: HTTPS://WWW.TIMETOAST.COM RETRIEVED, AUG 2022



HENEQUEN FACTORIES, THE GREEN GOLD. PHOTO: HTTPS://WWW.MINDOMO.COM RETRIEVED, AUG 2022

The cultures that prospered in the area were different, but shared common traits, such as cultivation of maize, beans, squash and chilis, building stepped pyramids, ball courts, two calendars (one civil and one religious), pictographic writing, common gods such as the god of rain, wind, fire, and many others (Kirchhoff, 1943).

The cultural similarities seem to be because they present a common agricultural strategy in response to certain environmental constraints which are also common, despite the climatic[1], ecological, biological, ethnic, cultural, and linguistic diversity that characterizes the Mesoamerican territory.

In Mesoamerica, neither soil management technology (plow and tractor), nor water management (canals and reservoirs), (except in the last period of Aztec Empire and maybe in the Maya lowlands during the Classic period), have been favored by topographical features or by the configuration of their rivers, together with the presence of hurricanes and cyclones (Teran and Rasmussen, 1994).

The Agricultural and Productive Strategy: Polyculture and Productive Diversity

A common condition of Mesoamerican ecological diversity has been its high climatic variability (as cited by Garcia et al Barrera M. et al, 1977:51, and the probability that the average annual rainfall will fall anywhere in the country, it is always less than 50%). This factor creates great uncertainty about the success of the harvest.

Among the factors that influence the harvest success are environmental factors such as irregular rainfall, as well as other factors such as pests and diseases, which led to the promotion of an agricultural strategy based on breeding plants to withstand different ecological conditions through the artificial selection of *Phitoenetic material*. This strategy has been, for millennia, the core of a productive system that has fostered many activities.

The purpose of this strategy seems to be to guarantee production in an ecological context of great unreliability, rather than to increase the production as a monoculture production.

The milpa (understood as the basic polyculture composed of maize, beans, and squash) is the major instrument in this strategy. The cultivation of many plants that continuously adapt to different conditions and needs (ecological and cultural) instead of monoculture guarantees that at least one of them can prosper and grow in any uncertain context.

The Probable Creation of the Milpa System: Western Mesoamerica

This strategy seems to have been born in western Mesoamerica around 10,000 B.C., according to paleo-ecological, archaeological-botanical and molecular-genetic data (Zizumbo & Colunga, 2010).

Apparently, in the tropical deciduous forest of the Balsas-Jalisco biological province, hunter-gatherer groups started the domestication process of plants and agriculture, using fire as a tool. The sympatric distribution of populations that seem to be wild ancestors of maize, beans, and squash point to this region as a site of domestication. The food technology developed in this region between 4,500 and 3,500 B.C., it was much more complex than in other regions in that time, suggesting that this area was the origin of the milpa agri-food system. The ecological and nutritional complementarities of the system that we mentioned before were supported by the complex development of the Mesoamerican societies (Gepts, 2008).

The presence of domesticated maize and squash

1 Mesoamerica is located at the intersection of two biogeographic regions: the Nearctic and the Neotropical and has a topography and a geology of most climates, except the coldest. Due to the climate diversity, we find vegetation that includes desert scrub and thorn forests, coniferous and oak forests, cloud forest, rainforest (sub deciduous, deciduous and evergreen) and aquatic vegetation. Mexico, the main seat of Mesoamerica, is considered among the 17 megadiverse countries with between 60 and 70% of the planet's biological diversity (Perales and Aguirre, 2008). When the Spanish arrived, aboute 125 languages were spoken, and now, five centuries after the conquest, there are still 68 languages with 364 variants (INALLI, 2009).

granules and presumed beans on grinding stones from 9,000 B.C. shows that these species were simultaneously harvested and consumed simultaneously and may have been domesticated at the same time.

A study of the current diet in western Mesoamerica suggests the Mesoamerican diet, based on maize, beans and squash, and chilis, may have been formed in the pre-ceramic period before the species had been domesticated (Zizumbo-Villareal, 2012).

The fact that the consumption of these species was at the base of a culinary culture with nutritional complementarity since the Archaic period, suggests that it may have been one incentive for the development of the milpa system and the domestication of its species, acquiring not only nutritional complementarity, but agroecological complementarity.

Spread and Diversity of the Milpa in Mesoamerica: The Many Milpas of Mesoamerica

The spread of these domesticated species to the rest of Mesoamerica may have occurred through biological-cultural corridors. The agricultural milpa system may have been established between 7,000 BC and 4,400 BC.

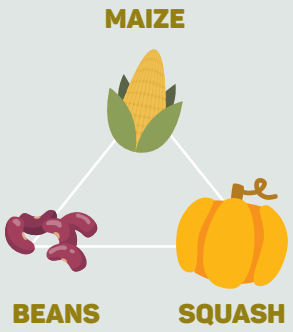
The diffusion of this triad began when they still expressed low genetic differentiation regarding wild varieties. Their transport to areas that did not have wild populations of the same may have sped up the fixation of traits and the disappearance of wild traits. Cultural and environmental conditions in each region may have promoted the initial diversification and explain, in part, why the milpa does not have a unique definition.

The milpa polyculture presents great diversity throughout the different parts of Mexico and northern Central America. The plants that make up the triad – maize (*Zea mays)*, beans (*Phaseolus spp.*), and squash (*Cucurbita*) – are the heart of the milpa, although they also present great diversity at their core. There are over 60 types of corn, precisely because there are variants of the original species that have adapted to the different climates, altitudes, soils, topographical features, etc.

The Yucatec peninsular maize does not grow in Tabasco or Puebla, and vice versa. The same thing occurs with beans and squash. Additionally, there is a great diversity of agricultural and cattle ranching techniques that have been developed by the *milperos* who manage the polycultural milpa: other crops, as well as other plant and animal resources for obtaining goods and services (Boege, 2008; Linares and Bye, 2011; Rodríguez Canto A. et.al., 2016).

Each milpa has been an agricultural laboratory in which multiple species have been domesticated, favored, and tolerated with various degrees of domestication and management. This shows that every

The plants that make up the triad



are the

heart

of the milpa

Mesoamerican milpa is unique.

The Mesoamerican strategy of the milpa polyculture survives in different places and under different forms, but it thrives especially well in places where ecological constraints are more drastic, as it is the case of the Yucatecan milpa, whose history will be briefly narrated.

III.C.2 The Milpa System in the Pre-Hispanic Maya Yucatec Peninsula

Preclassic Period (2,000 B.C. – 250 A.C.)

The earliest evidence of milpa agriculture and what can be called Maya culture in the Yucatan Peninsula are from Cuello, Belize before 2000 A. C. -during the so-called Preclassic period- in Cob Swamp (Hammond, 2008).

This evidence is very interesting because it confirms not only the existence of polyculture technology with the milpa triad: maize, squash and beans, but also the slash-and-burn technology, and the cultivation of fruits, roots, vegetables, and the management of animals such as the hairless dog, domesticated to be eaten (Clutton-b and Hammond, 1994). They found remains of deer (*Odocoileus viginiano*), tepezcuitle (*Cuniculus paca*) and wild pig (*Sus scrofa*).

These data are telling us that the milpa system existed since that time, because we find not only the polyculture milpa but also another productive activity as fruit crops, vegetable crops, animal husbandry and hunting, as in the current milpa system.

The Yucatan Peninsula cities, such as Dzibilchaltun, Komchen and Tipikal, flourished.

Classic Period (250 A.C. – 950 A.C.)

During the Classic Period, when the Maya culture reached its maximum flourishing, there is evidence of agricultural intensification in the so-called southern Maya lowlands, where the culture developed its most impressive expression.

To sustain large cities such as Tikal, el Mirador, or Becal, intensive agricultural systems such as terraces (Turner, 1979, 1983), canals associated with elevated fields, or drained fields in lowlands (Harrison, 1977, 1993; Scarborough, 1983), and others associated with the detour and exploitation of river channels (Siemens and Puleston, 1972)[2].

These systems could not have existed in the Yucatan Peninsula, in the northern lowlands, except in the Puuc region of the south and southwest of this region, or in its eastern portion because their ecological limitations prevented them (thin, stony, and permeable soils).

Despite the certainty of the agricultural intensification of the southern Maya Lowlands:

1. Its distribution shows that it was a dispersed event and was located in sites with ecological conditions that made it possible, as the evidence reflects.
2. The crops sown in elevated fields and terraces were those of the milpa polyculture, therefore, the *milpa polyculture remained alive in the intensive plots.*
3. Intensification did not require slash-and-burn cultivation.

2 In 1983, Ray Matheny et al. reported a large and complex system of canals and water reservoirs at Edzná built during the Preclassic (20 km from our study area), but did not have time to look for traces of elevated fields, although they indicated that the amount of water managed was much greater than necessary for population use. Like Matheny et al. in Edzná, Mary Pohl (1990) found evidence in Belize of wetland use and the modifications with drainage canals since the Preclassic period. In 1996, Fedick edited a book with more than 20 chapters on the various modifications and uses of different types of soils, including terraces and fields drained by canals as well as other types of pre-Hispanic modifications not previously reported. In 2003, Gómez Pompa et al. edited a book with more information on these agricultural intensification systems and the management of the forest, wetlands and other natural resources by the prehispanic Maya. In 2004, Kunen documents several agricultural land modifications in the "Lower Far west" of Belize, built during the Preclassic and in use until the Postclassic.

MAP 7. THE MAYAN LOWLANDS

SYMBOLOGY

- MAYA SITES
- REGION

SOURCE: Fernández, Tomá and Tamara, Elena "La cultura Mya"
In Biografías y Videos. La enciclopedia en línea. [Internet]
Spain, 2004. Available at http://wwwbiografiasyvidas.com/historia/cultura_maya.html [date of acces, January 12, 2022]
Coordinate System GCS WIGS 1984
Datum WIGS 1984
Units: Degrees

4. Slash-and-burn continued to contribute, to a large extent, to sustain the population during
5. the 1500 years of Maya civilization, at least in the northern plains and the portions of the Maya lowlands where intensification with ridges and canals or with terraces was not possible.

It should be noted that in the Yucatan plain of the northern Maya lowlands, which is the most extensive area of the Yucatan Peninsula, the slash-and-burn technology of the milpa continued to be predominant during the Postclassic period and can be seen in the 16th century sources, which narrate the agricultural landscape encountered by the Spanish people.

Postclassic Period (950 - 1525)

Evidence that the milpa was the dominant system at the Spanish arrival is found in early colonial sources, mainly among the *encomenderos* who wrote the 50 *Relaciones de la Gobernación de Yucatán*, between 1579 and 1581 (De la Garza, 1983), and Bishop Landa, who wrote his book in 1574 and 1575 (1982). Colonial dictionaries also enlighten

UXMAL ARCHAEOLOGICAL SITE. PHOTO: THE NATURE CONSERVANCY

milpa agriculture (Barrera et. al., 1980). From their reading, it is clear that:

It was carried out under slash-and-burn technology and the associated triad of maize, beans and squash and other species and variants. Terán and Rasmussen, in 2008, reported the existence of 9 families, 16 species, and 36 variants in the sources of the 16th century.

Several plots were cultivated (probably first, second, and third year milpas), and the sowing season was the same as today, in May or June. Two weedings were carried out. The doubling of corn and the harvest is mentioned, which refers to two crops in the Puuc area. Transportation was done by people since there were no farm animals to do it, and the corn was stored in silos. The shelling of corn, similar to today, was done with sticks *-pu'ch-* o by hand *-p'el-*.

In the fallow, 4 successively phases of vegetation are mentioned in the sources 1) *pokche'el kol*, milpa dejada or abandoned, in which scrub and undergrowth predominate (Barrera V. et al., 1980: 662) corresponds to the first phases of secondary succession; 2) *cab - ala che'* was a low monte, with small trees, which corresponds to the current *hu'che'*. It is a more grown phase of vegetation. 3) *cana-che*' was the high monte and 4) a term that alludes to a type of *monte* that no longer exists: *zuhuy kax*, *monte virgen* that had never been worked (Álvarez, 1980: 133).

Although there is no data on production, we assume it was more than self-sustaining, since there was a surplus to sell and pay taxes.

Some examples of detrimental factors to the milpas were locust attacks (Schisticerca spp) (Landa, 1962. Barrera V. and Rendón, 1980), droughts, and hurricanes. To cope with scarcity, it is said that they resorted to herbs, fruits, and roots, a strategy that still existed a few years ago. 20 species are mentioned, and 13 were cultivated and remained in the "abandoned" montes, which shows that it was a strategy implemented from cultivation to store food in times of crisis. This strategy survived until the beginning of the 2nd century in the towns of eastern Yucatan and the Maya Foresy of Quintana Roo (Terán and Rasmussen, 2008).

All the sources show that agriculture depended on the rainy season and the impact on the vegetation can be seen in the comments of people such as the messenger's grandson who said, "this region is not very mountainous because of the tillage and milpas of the natives" (De la Garza, M. 1981). These reflect the predominance of the milpa under RTQ, as the dominant agricultural system.

Postclassic Sociopolitical Organization at the Time of the Conquest

The so-called Maya collapse of the southern Maya lowlands did not occur throughout the north. In the Yucatecan plain, coastal trade favored the flourishing of cities such as Chichén Itzá, which achieved the last significant expansion of power and important unification.

This center of power was replaced by Mayapán, whose leadership ended in the 15th century, and when the Spanish arrived, power was dispersed in 18 political centers in which the halach uinicob (great men) ruled, on whom the batabob, (chieftains) depended more for social ties, than territorial (Quezada, 2012). The Maya called this network of socio-political relations cuchcabal and the Spanish called it province.

The settlement pattern was dispersed. At the base, the political organization comprised a residential unit, or caserío which the Spanish called neighborhood, made up of houses inhabited by up to 6 families. The neighborhood provided labor and products to the elite and formed the armies.

The second level was the batabil, or lordship under the dominion of the batab or cacique. It was politically and administratively subjected to a group of neighborhoods and lived in one of them, called township by the Spanish. The neighborhoods were distributed in the mountains, and their administration was carried out by ah cuch cab designated by the cacique. Other functions were to summon their neighbourhoods for war, festivities, and tutelary ceremonies.

The third level was the *halach uinic*. The position was inherited through the paternal line and its functions were religious, military, judicial, and political.

The social classes consisted of nobles, workers, and slaves. The nobles were only nobles by lineage. Only they could occupy political, administrative, and command positions. Priests, merchants, and rich farmers were also nobles. Enslaved people were prisoners of war, except for the nobles, who were sacrificed.

During the Preclassic period, cities such as Chichén Itzá, Mayapan, Tulum and Xcaret flourished.

III C.3 The Milpa Maya during the Colonial Period

Ecological and Labor limitations

The Spanish conquerors who arrived in the 16th century did not find the metals like gold and silver in the Yucatan Peninsula that they coveted so much. They found stony, thin, nutrient-poor soils that, combined with a highly variable rainfall regime and the absence of surface water because the soils were very permeable, prevented the sowing of their crops and favored the continuity of Maya crops. The wealth that they found was a large and well-organized Maya population for production based on their fantastic technological adaptation to the region and with a great linguistic, cultural, historical, and organizational homogeneity that favored the survival and gradual but growing enrichment of the Spanish, from their super-exploitation.

This allowed the milpa system with its components to survive the Spanish colonization with minor technological modifications, but sufficient to favor an overexploitation of the labor force.

Continuity and Change of the Yucatecan Milpa in the Colony

DEER IN THE FOREST.PHOTO: THE NATURE CONSERVANCY

The milpa continued to provide food until the mid-18th century because Spanish crops could not grow on the lands (Landa, 1982).

The other components of the system, such as meliponiculture, hunting, animal husbandry, and cultivation of solar plants, extraction of timber and medicinal plants from the forest and weaving cloth, continued to be practiced until the end of the 18th century, with the culmination of the alienation of Maya lands, which was carried out by the Spanish through various processes.

Although the milpa system was maintained, there was an alteration in the way it had been developed in pre-Hispanic times, due to the introduction of metals and some animals and plants (Hoil, 2010).

The milpa polyculture and the great diversity of milpa vegetable crops, like the *pachpakal*, continued to feed the entire colonial population. In the 16th century, only one new milpa crop is reported: the plantain. Other crops were introduced, but in solar cultivation.

The Spanish introduced iron (axes, trees, machetes, hoes) that boosted the work of the milpa since the 16th century.

As cotton fabrics became their main tribute, their elaboration by Maya women became very important and imposed the cultivation of the land with cotton.

Hens and roosters were introduced to the land, which reproduced easily because they were previously bred, “hens of the land”. Pigs replaced the bald dogs, xoloizcuintles, which they raised for their meat, and quickly entered the Maya diet and their meat, like that of the turkey, that was used for ritual meals.

Among fruit trees, they introduced oranges,

lemons, limes, pomegranates, and vegetables, such as lettuce, cabbage, cucumbers, chickpeas, radishes, onions, garlic, and medicinal plants such as mint, rue, cilantro, and parsley.

They adopted the use of horses, donkeys, and mules, which was important because before this, the load was carried by porters called *tamemes*.

These animals and crops still exist today in the Maya plots.

Cattle were introduced, and played an important role in the Maya economy during the colonial period, since the Spanish allowed them to generate funds for worship and community expenses, not to mention the economy of the conquerors.

Hunting continued to be carried out in the same way, but the animals were sold to deliver money to the community for town expenses and for alms to the friars, so it increased.

Beekeeing also continued to be carried out as before, by raising Melipona bees and by collecting wild bees in the bush. But like hunting, it increased because wax was the main tribute, along with cotton fabrics. Its collection took time away from their milpas and other tasks because they had to go far away from their homes and into the bush to collect it in trees, caves and hollows, and they had many accidents.

During colonial times, the Indians cultivated 4 types of milpas: the community milpas, whose products were sold for the community fund, the cacique milpas, of 60 ropes, the milpas of the cofradías, which were to pay the cowboys who took care of the virgin's cattle to support the cult, and the milpa of the *milpero* to support his family and pay for his alms and tributes (Hoil, 2010).

Concentration of the Maya Population; Congregations, Demographic Crisis and Republic of Indians

An important process for the control of the Spanish over the indigenous population and their authorities was the concentration of the population, previously dispersed throughout the peninsular mountains, and the creation of the Republic of Indians that largely preserved the political organization (and economic in the case of Yucatan) to facilitate the control of the population through their own authorities.

The pre-Hispanic provinces populated by *caserios* formed by up to 6 families, scattered throughout the territory, and were concentrated into neighbourhoods from the second half of the 16th century. The Maya were transferred to live in the places where their *caciques* (*batao'ob* in Mayan), who were their immediate authorities, were located.

Population concentration favored the spread of new diseases that entered with the Spanish and decimated the population. In 1549 there were 232,576 inhabitants and by 1586, 1,700,000, a decrease of 27% in only 37 years (Quezada, 2012).

The reduction or concentration of towns was prior to the construction of what was called the Republic of Indians in the Indiana Monarchy of the Spanish Empire. In them, the traditional authorities of the Indians were preserved, the caciques, and city councils were formed, considering that it was a matter of organizing the communities according to their sociopolitical reality, different from that of the Republic of the Spanish.

Both republics shared the Republic or major Monarchy, with a constitution, common authorities, and a common church.

The Republic of Indians was sustained by the community funds that were formed with a part of the tributes of the Indians and were administered by the city council, who was also in charge of collecting the tributes. (Levaggi, 2001).

Mechanisms of Exploitation of the Maya

The encomienda tribute allowed the Maya to obtain products mainly so that the encomenderos could subsist; the real de doctrina was the payment for the indoctrination to the new religion imposed by

the Spanish; personal services, although demanding and poorly paid, helped the Maya to pay tribute and gain food during famines, and finally, the main driving force of the regional economy, of a rentier and seigneurial nature, which was the system of distributions for the production of cotton blankets, which boomed since the last decade of the 16th century. The latter made it possible to amass the first fortunes (Bracamontes, 2007).

Despite the overexploitation of labor and products through taxes, commercial production, and services, the Maya preserved their territory, their milpas, and their republics and had businesses that allowed them to generate profits to help cover their taxes and pay the religious festivities of their towns.

The *Mulmenyah*, Collective Organization of Community Labor

To understand the collective Maya response capacity to fiscal pressures, it is necessary to comprehend a traditional organization form called *mulmenyah*, based on mutual aid and cooperation, which was preserved in recent times.

It was applied towards the authorities and among the community. If a house had to be built for a lord, it was done among all and without payment, but the same applied to each person based on "rotation", or what the Spanish called *rueda y tanda*[3]. The *caciques* received orders from the Spanish and transmitted them to their people, who organized themselves collectively based on the mulmenyah (Ortiz, 2001).

The word *mulmenyah* became *lunesmenyah*, a day established to provide free labor during the colony. From here came the alms, distributions, personal services, merchandise, and labor, which formed the surplus extracted by the Spanish. They are the predecessor of the luneros that made up the labor force of the *henequen haciendas* of the 19th century.

The *mulmenyah* is "…key to understanding the slow but sustained growth of Yucatecan colonial society until the 18th century" (Bracamontes, 2007).

Land Dispossession and Haciendas and Cattle Ranches

The complement to the exploitation of indigenous labor was the gradual and increasing process of dispossession of Maya lands by Spanish.

The corn, cattle ranches and haciendas were the agricultural enterprises that dominated the peninsular landscape around the mid-18th century and were the basis for the large henequen haciendas that made Yucatan the richest economy at the end of the 19th century and beginning of the 20th century.

Creoles, *mestizos*, and *encomenderos* promoted the formation of *haciendas* and *estancias* at the cost of undermining the assets of the indigenous republics, their forests, their political territories, and the corporate organization of their labor force, which competed with the hacienda for land and labor.

A policy of disentailment was started: of the community funds, of the *cajas de cofradías*, of the *haciendas de cofradías*[4] that are community funds and the dispossession of communal lands was promoted. By 1780, 78 of the 117 registered estancias had already been sold (Quezada, 2012).

By 1795, there were 872 cattle ranches that soon became prosperous haciendas, and private ranches of sugar cane, corn, rice and dyewood proliferated.

All of this was detrimental to the people. The consequence is that they leased their lands to the hacienda owners, and the *caciques* lost their authority as the authority of the hacienda owners and the forepeople increased. The *mestizo* and *mulatto* cowboys and the hacienda owners received a monthly salary. The Maya could cultivate hacienda

3 For example, for the tribute of cotton blankets, each woman was given her own thread. All the thread was spun from all of them and then each one wove what she had to deliver. In colonial times, mulmenyah was used in the milpa, in women's weaving, in construction, in hunting and fishing, to pay tribute to the Spanish. Within the community, it was used on the basis of reciprocity, that is, the return of the help received in any of the aforementioned activities.

4 These funds and the community ranches helped with the expenses of the civil and religious community; to face critical agricultural years; to face illnesses and deaths. Their disentailment generated a strong insecurity in the communities.

HACIENDA. PHOTO: THE NATURE CONSERVANCY

lands for a Monday day of service. The Maya lunero who changed residence to the hacienda left the circle of exploitation represented by tribute, distribution, ecclesiastical changes, communal work, and personal services (Bracamontes, 2007).

By the mid-18th century, the Maya population had been segmented into two: 1) the Maya of towns and ranches in conflict with cattle ranchers and hacienda owners, governed by commissioners, caciques and republics, and 2) the servants of the haciendas, under a regime of indebtedness and labor discipline, who lived inside the fincas in towns under the supervision of servants.

At the beginning of the 19th century, almost a third of the Maya population was already in the category of agrarian servitude, and the towns were facing a growing dispossession of their lands.

The Maya Resistance: The rebellion of Jacinto Canek

Since the Spanish arrival, there is evidence that the Maya resisted the exploitation and dispossession of their forests to which they were subjected through complaints and revolts. The Maya of the south and east took refuge in the forests where the free Maya lived, practicing their ancient rituals and escaping tribute, abuse and mistreatment. However, it was not until 1761 that a rebellion broke out, threatening the white population.

The rebellion broke out on November 17 in the village of Quisteil during the feast of the Virgin of the Conception, with the death of a white merchant and the flight of the priest who officiated the mass and who warned of the event. On December 14, the governor sent forces from different points, since it was feared that the rebellion would spread, and culminated with the cruel execution on a scaffold of its leader, Jacinto Canek, 8 *caciques*, and multiple indigenous people who joined the movement. The village where the rebellion arose was burned and salted so that it could never be populated again (Bracamonte, 1994).

III.C.4 The Maya Milpa During the Independence (XIX Century)

General Overview

At the beginning of the century, Mexico declared its independence from Spain (1821). Mexico entered an unstable political stage of constant struggles between federalists and centralists. Yucatan separated from the federation in two occasions. Campeche separated from Yucatan and Quintana Roo in 1901. The Maya declared war on the whites in an event called the Caste War. As punishment from participating in this war, 1,000 people were sold to Cuba to work as slaves in the sugar plantations.

This unstable context did not prevent the advance of the private appropriation of Maya lands, which had begun in the second half of the 18th century. Finances rested on the multiple obligatory contributions of the Indians and not on the sale taxes, regularization of wastelands[5], export and import of products, all of which could be collected from those who enriched themselves at the expense of the Maya lands and labor.

In the second half of the century, the progress of the *henequen* industry and the modifications it implied in all areas of regional life were the economic process that marked the history of Yucatan.

Dispossession of Indigenous Forests, Lands, and Waters

In 1823, sugar cane production began and in 1825, a general law was passed that facilitated the acquisition of wastelands as private property, attracted foreign immigrants and stimulated the colonization of supposed wastelands. In reality, the wastelands were the fallow milpas of the Maya people, which had been alienated since the second half of the 18th century. (Quezada, 2012).

In 1841, the federals ordered that the communal lands of the towns, called *ejidos*, to be limited to 4 leagues from the main square of the towns, and on the farms, only one league was allowed. Beyond this area, they were to be considered being colonizable wastelands.

This process was exacerbated when federals, who had no resources, paid General Santa Ana's army with communal lands.

A war was also unleashed over water for the development of cattle ranching, which was encouraged on the lands that had been taken from them. Wells, watering holes, and *cenotes* were the object of dispute and the affected towns lost the ancient indigenous custom of common waters.

After this territorial dispossession, by 1845, there were already 1,390 farms of non-Maya landowners who developed and promoted the following crops and commercial products, such as Palo de tinte in Tekax and Campeche, and in Valladolid, Tekax and Campeche corn for commercial purposes, rice, tobacco, and sugar cane. (Bracamonte, 2001).

Henequen Haciendas

Since the pre-Hispanic times and until the end of the 18th century, the cultivation of henequen and the production of fiber, rope, sacks, and other products was the monopoly of the Maya. By 1815, the *haciendas* of the coastal area were already dedicated to satisfying the demand for sacks, cables, and ropes, and in 1839 it was already recognized as an export zone to the United States to supply ships. The work was manual and the laborers, *luneros*, worked for meagre wage and for corn.

At the end of the 19th century, most of the *hacienda* workers were *luneros*. They had to be married, and they lived in servant towns around the *haciendas* with their families. They had small plots of land where they grew small crops, with water, firewood, hunting rights, and a milpa as an obligation to their bosses. Indebtedness was the way to force them to

5 Land "not occupied" for production, that is, land that, from the point of view of the *milpero* system, was fallow, was considered uncultivated. As the availability of land for milpas decreased, this began to affect the *milpero* system and generated many protests by the Maya.

live permanently inside the towns, in a pigeonhole. There were also tenant farmers that made milpas for giving part of their harvest to the landowners.

The work of "*luneros*", the existence of tenant farmers, and casual day laborers (who were also employed in the rice or sugar cane farms) were the fate of the Maya population that was left without land, although some took refuge in the southern mountains, thus escaping the fate of servitude and misery.

In 1852, a wheel was invented and started an industrialized process for shredding henequen stalks. In 1859, a steam engine was incorporated and in 1876, there were 450 steam scrapers and 31 animal traction ones. That same year, 32,000 hectares of agave were already being cultivated for export. That year was followed by 100 years of boom and development of the so-called "green gold".

Until 1915, the government of Yucatan was in charge of an oligarchy supported by President Porfirio Diaz. Yucatan was a mono-producer and a mono-exporter of raw materials, and the Yucatecan oligarchy was not interested in industrialization or diversification.

It is important to point out that both *hacienda* laborers and the tenant farmers cultivated milpas, so although henequen became the engine of the Yucatecan economy, the milpa remained alive, not only in the eastern and southern regions where henequen did not reach, but even the northern peninsula where the Henequen (a.k.a. green gold) established its empire (Bracamonte, 2007).

The Caste War

The 19th century was "the century of the indigenous rebellions", because it was the response to the great dispossessions of indigenous communal lands throughout the Republic. There were rebellions everywhere. The most outstanding were those of the Yaquis of Sonora and the Maya of Yucatan. A reaction from the Maya was to be expected. They faced the dispossession of lands, the increase in

PHOTO OF A HENEQUEN HACIENDAS. HTTPS://WWW.ISTOCKPHOTO.COM/ RETRIEVED, AUG 2022

taxes and subsidies, and the miserable payment for services.

On July 26, 1847, the indigenous leader Miguel Antonio Ay was arrested and shot, and this was the breaking point of the indigenous nonconformity. It began in Tepich with the murder of 30 families and the cry of "*mueran los blancos*". The warning against the white population, commanded by Cecilio Chi, was about to be won. (Bracamonte, 2007).

The indigenous advance was shocking because even the *hacienda* and farm servants joined the confrontations. There were attempts to reach agreements with some leaders in March 1948, but the most radical ones did not accept the conditions and the war continued. The state did not have the forces to confront the Maya, so the Mexican government offered the United States, Great Britain, and Spain the surrender of the peninsula if they helped them in the war. But they were no positive responses.

In May 1948, the rebels had occupied 4/5 parts of the peninsula and only needed to take Merida, Campeche, and the nearby towns, but when they were 6 leagues from Merida and 1 from Campeche, they retreated, to everyone's surprise. The hypothesis of this event was that the rains began, and it was

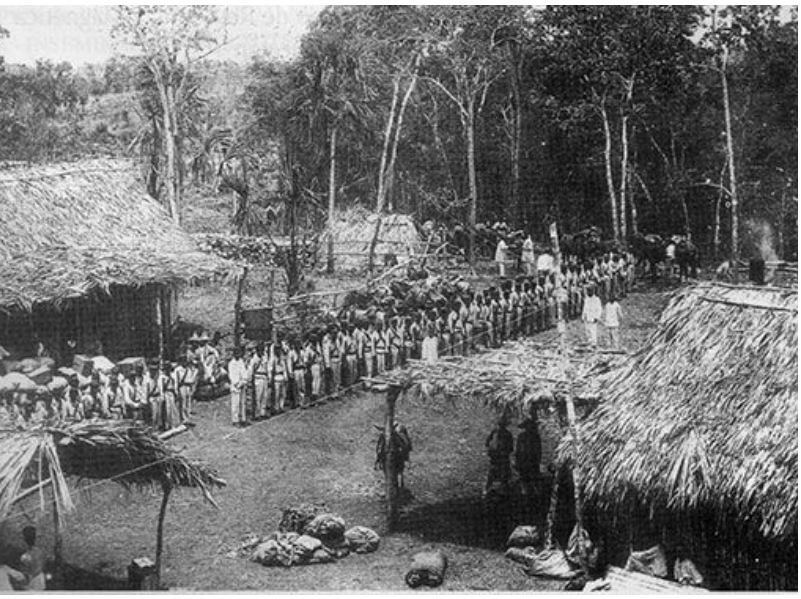


PHOTO OF THE CASTE WAR. HTTPS://LECTAMBULOS.COM/ RETRIEVED, AUG 2022

necessary to go sow because if they didn't, there would be no harvest at the end of the year.

From then on, the governmental counteroffensive began, and in 1850, a *Cruz Parlante* commanded the war – according to the Maya vision -, through its messages, from Chan Santa Cruz. The cult still continues, although greatly diminished in the forest of Quintana Roo and the east of Yucatan. The war officially ended in 1901, but for some Maya, it is a truce, and the *Cruz Parlante* continues to travel through different townsw in the Maya area.

III.C.5 The Maya Milpa During the Mexican Revolution (XX Century)

The Mexican Revolution was a social and economic movement that changed the relationship between *milperos* and landowners and between landowners and the land, and with Yucatan, with the forest or jungle through agrarian distribution.

In Yucatan there was no armed movement. The Revolution was exported by the federal government starting in 1915, However, in the 1920s when the henequen export agroindustry was at its peak, the federal government did not affect the agrarian structure and only distributed the so-called wastelands of the haciendas, which were those that not plant henequen, to form the *ejidos* of the towns, but it did hit the ruling class by stripping it of the monopoly control of the henequen export. The federal government appropriated the commercialization of henequen.

The rural population, workers and neighbors of the towns, continued to be linked to the haciendas, mostly. They earned wages, farmed in the private hills in times of scarcity or drought, and bought corn at low prices in the hacienda stores.

From the first stage, conflicts arose between the hacienda laborers and the tenant settlers in the towns. The wastelands of the *haciendas* that were distributed, were first worked by the laborers or by the tenant farmers who were *milperos* of the towns so as not to affect agro-export production.

The expropriation was detrimental to the *milperos* of the *haciendas*, who had the right to work them as day laborers, and to the *milperos* of the tenant towns, since the former saw in the distribution a "dispossession" of the forests they worked (even though they were not their property), and the latter saw the opportunity to work them without paying rent.

In the 1920s, as the boom in the production and sale of henequen continued, the conflicts between these two groups of workers were not so acute because there was work on the *haciendas*, but in the with the world crisis due to the war and the fall in henequen production, which caused a drop in wages and lack of employment. The conflicts between the *hacienda* workers and day laborers in the towns worsened, which led to the drop in wages and lack of employment. In addition, in this decade the agrarian reform was radicalized and in 1934, the distribution of the henequen plantations from the haciendas to the current *ejidos* began (Ortiz, 2011).

The *peones acasillados* resisted this distribution, while the town workers gladly accepted it. It is

important to note that, although a link that was maintained with the plantations and the shredders for monetary payment, the milpa helped to overcome unemployment and low wages for both groups of workers.

In 1938, 80% of the land under cultivation, 74% of the land under exploitation and 97% of the uncultivated area were distributed in the henequen zone and in 7 months the National Bank of Agricultural Credit organized 247 *ejido* credit societies and granted them loans for over 16 million pesos. In total, 500 landowners were affected.

It is important to point out that, although during the henequen boom, most of the population was concentrated in the haciendas, the fall of henequen production and the agrarian distribution of the population in which the towns concentrated most of the population and the cities began to grow.

At the end of 1930, 386,096 inhabitants were distributed in 3 regions: in the northwest ¾ of the population was concentrated and 60% of the region was occupied by henequen plantations, but where the milpa continued to play an important role in self-consumption. Another region that started from the coast towards the border of Quintana Roo and to the east and north of Valladolid, was a region where the logging companies had deforested it and the Maya *milperos* produced cattle in addition to their milpas. The third region, whose vertexes were Valladolid, Peto, and Muna was properly in the milpa region. In this region, the agrarian distribution had been carried out with more intensity, but the *milperos*, although with *ejidos*, continued to work on the collective use of the forests. These two regions supplied the henequen northwest with corn and meat.

III.C.6 The Maya Milpa After the Mexican Revolution (XX Century)

From the Porfiriato (1876-1911) until 1970, the

Although during the henequen boom, most of the population was concentrated in the haciendas

axis of the Yucatecan economy was henequen. Until 1929, with a productive book and international demand, and after that date with a decreasing market and production because of the crisis due, in part, to the competition of Asian and African countries with better yields; to the competition with synthetic products at the beginning of the 1970s; to the economic paralysis of the years that followed the agrarian distribution in Yucatan, and to the corruption with which the henequen company was administered after the state intervention. In 1984, the state promoted a reorganization of the henequen zone and in 1992, 30,000 *ejidatorios* were liquidated and 12,000 retired. At the same time that henequen was falling, other alternatives were being generated: industrial poultry production began in 1960; tourism began in Quintana Roo in the mid-1970s and since then has attracted a lot of *milpero* labor from Yucatan and Quintana Roo; large-scale soybean cultivation in Campeche was promoted since 1980; in the last decade of the 20th century, industrial pork farming in Yucatan received a great boost. (Garcia et, al., 2018)[6].

6 It is important to clarify that in the other regions, despite the fact that the economy was articulated around monetary entrepreneurial activities such as citrus production, fishing, cattle ranching, and henequen production, the milpa always remained present in one form or another, adapting to the rhythms set by changes in regional dynamics. Another important fact is that, as wages

The milpa crisis

The sowing decline of what was once the most important economic zone in Yucatan, regions such as the coastal fishing zone, the eastern cattle zone and the southern citrus zone emerged in Yucatan (Villanueva, 1990). The eastern milpa region, which had always been milpa, was merged with the agrarian distribution, but later in the 1970s, it was in crisis because of the increasing loss of land due to the growth of other agricultural activities, particularly cattle ranching. This forced the population to migrate in search of work to compensate for losing of fertility of the milpa (caused by the decrease in fallow years because of the lack of available land) with the purchase of fertilizers, and to buy pesticides to attack the growing pests and diseases derived from the burning of young forests, which do not control the attacks of these pests and the growth of weeds.

Processes that have exacerbated the initial crisis

The processes that led to the crisis and the growing need for money (demographic and business growth at the expense of the fields) have continued until today, exacerbated by the processes mentioned below:

Government Agricultural Policies Towards Farmers and the Private Sector (CRUPY Report Rodríguez, A. et. al., 2016). The *Ejidal* Bank (1980-1989) granted loans for fertilizers and herbicides[7]. Subsequently, PRONASOL (National Solidarity Program) administered by the CDI (National Commission for the Development of Indigenous v) provided subsidized fertilizers and herbicides.

Amendment to Article 27 of the Constitution. A new Agrarian Law, approved in 1992, gave the *Ejidos* (groups of *milperos* who shared and farmed common land) the authorization to rent or sell their agricultural lands and make settlement contracts in association with private capital. This was the legal basis established for the sale of *ejido* land. Extensive Cattle Ranching. This industry replaced endemic forests with thousands of hectares of grassland, and in the three peninsular states, a great percentage of irreplaceable land was lost to the milpa. Cattle ranching replaced the diverse vegetation of the forests and jungles with a single plant species (grass) and this is a permanent situation. The government favored cattle ranching and relaxed the rules for the purchase of milpa land by private individuals.

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a. The Emergence of Advanced Groups in Plantation Agriculture and Mechanization

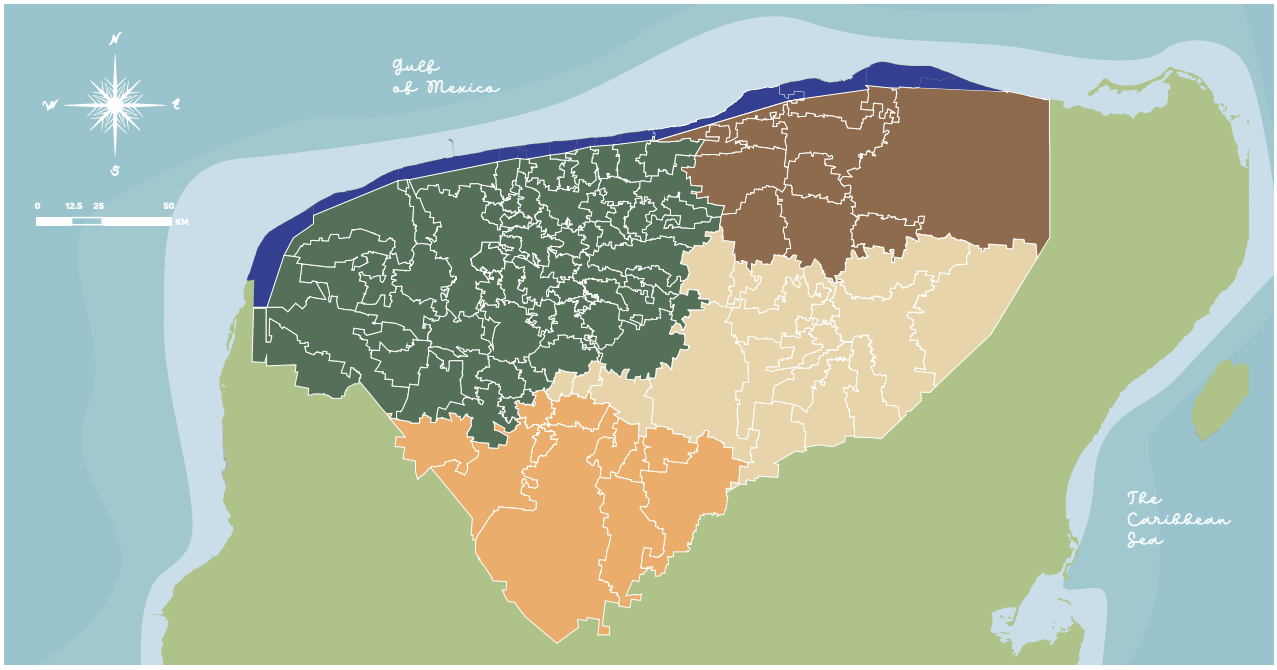
Examples of these are the Mennonites and farmers in the central and northern states of the country who introduced industrialized technological packages and are responsible for the introduction of transgenic soybeans, which immediately damaged the beekeeping industry. These farmers impact resources. But they are also favored by governments.

Natural resources protections laws have been made so that milpa activities are now penalized[8] (SEDUMA, 2015). They have been implemented thematically and by sectors. They establish that requirements and authorizations are required for each of the basic survival needs of the *milpero* family (food, housing, energy, health, etc.). The integrated and diversified habitat that *milperos* traditionally

have always been low, the milpa and its associated productive activities have subsidized *milpero* families. Another aspect to highlight is that beekeeping has been one of the activities historically linked to the milpa and in recent times has played an important role in bringing money to milpa families (Becerril and Hernandez, 2020).

7 Herbicides were not so enthusiastically accepted at first because along with weeds, the associated crops were also eliminated, but this was gradually introduced.

8 "Now if you cut wood you have to ask permission from the government. The rules are made against the ejidatarios. You can no longer hunt. Before the rules were better and so was the ejidos management."



MAP 8. AGRICULTURAL REGIONS

SYMBOLOGY

- COASTAL
- FRUIT GROWING
- LIVESTOCK
- HENEQUEN
- MILPERA

SOURCE: García, Ana, Terán S., Cervera M. Ma. Dolores, Cortes C. Gabriela, Aranda, Angélica L., Briceño Ch. Briceño, Franco C. Iván. (2018). "Modernización Centralizadora (1955-1991)". In Atlas Histórico y Cultural de Yucatán. Coordination Enrique Florescano, Sergio Quezada, Jorge Esma Bazan. Pp. 299
Coordinate System: GCS WGS 1984 Datum: WGS 1984
Units: Degree

used can no longer be implemented because of these new regulations. This has resulted in the perception of farmers as environmental offenders.

b. Other Social, Cultural, Legal and Economic Processes that Exacerbate the Crisis of the Traditional Milpa

The establishment of large national and foreign consortiums for pork and poultry production, the massive temporary and recurrent migration of young people (to the Riviera Maya and the United States, mainly employed as construction workers, servers, cooks, and gardeners); the growing female labor migration (to urban centers to work as maids, laundresses and nannies and to the Riviera Maya to work as servers, cooks, and laundresses); educational policies are a factor that is influencing young people to no longer want to work in the milpa (formal education does not consider ethnic differences, does not favor the parallel use of Spanish with indigenous languages, and does not propose options for training of professionals and technicians to support milpa agriculture)[9]; the change in eating habits has resulted in the loss of the traditional Maya diet,

9 Technical and agricultural professionals are educated with a Eurocentric vision. Due to the lack of opportunities, many families encourage their children to leave the community and not work in the milpa. In a workshop with *milperos* held in Morelos, Quintana Roo, among the difficulties facing the milpa today, it was mentioned: "The children's education is focused on going out to look for work outside instead of staying in the milpa". In Xcocmil they said: "The study simply follows the milpa because there is

and foreign species and varieties are affecting the health of the Maya.

Part D. Comparative Analysis: Comparison of the Milpa Maya with Other Traditional Agroforestry Systems in Mexico

In this section, we review the characteristics of some of the traditional agroforestry systems (SAF) that have been developed and practiced for a long time in Mesoamerica, in order to carry out a comparative analysis that allows us to identify aspects that the peninsular Maya milpa or Kool shares with them, as well as their particularities and to see how the milpa polyculture is present in most of them, being the basis of the Mesoamerican diet. It will allow us to appreciate that each milpa system is different according to its adaptation to the different ecological conditions in which it develops. Culture also influences these adaptations, but they are not analyzed in this comparative.

For this brief analysis, we focus on the ecological and agronomic characteristics of 6 of the 20 agroforestry systems in Mexico described by Moreno-Calles et al. (2013)[10]: (1) *Kool or Maya milpa*, (2) *Tlacololol*, (3) *Chinampa*, (4) *Metepantle*, (5) *Calal* and (6) *Cacaotal*. The features considered for this comparison are the location, the ecosystem and its biophysical characteristics, some biocultural practices and the fundamental problems.

The comparison between agroforestry systems points out the importance of biocultural diversity, as well as the associated ecosystem and economic benefits. Some of the biocultural practices shared among Mexican SAF are:

- The use of windbreaks to delimit production units by arboreal structures, which provide natural shade and buffer hurricane winds.
- The recovery of vegetation as a mechanism to recover ecological conditions for agricultural, cattle ranching and forestry production, and associated techniques.
- Self-sufficiency as one aim of agricultural, cattle ranching and forestry production.
- Pest control techniques
- Techniques to facilitate microclimatic conditions that enhance interactions between species

1) Hereafter, we will take as a comparative reference the milpa or "*Kool*" of the Yucatecan Maya, which is widely practiced, as we have pointed out, in territories located in Campeche, Yucatan and Quintana Roo. In these three states, that together make up the Yucatan Peninsula, the warm-sub-humid climate dominates, with a high presence of hurricanes in the middle of the year and with a temperature/vegetation gradient that makes it dry in the northeast while increasing its humidity as we move towards the southeast. The altitude at which this milpa is practiced ranges from 9 to 1000 meters above sea level, with a predominant geomorphology composed of limestone rock with a stony surface and a very thin layer of calcimorphic soil, poor in nutrients due to its age, origin and composition (Terán and Rasmussen, 2008). Rotation crops associated with the Maya milpa include maize, beans and squash, and other crops that may vary, such as jicama, macal, tomato, vegetables and introduced plants such as melon, watermelon and cucumber.

The production obtained from the traditional milpa is for family and community self-sufficiency, and is an activity that ensures family nutrition, but unfortunately, since 1970's, harmful practices such as the use of fertilizers and agrochemicals[11] continue

no adequate teaching, so everyone wants to go somewhere else when their studies end."

10 Moreno-Calles, Ana Isabel; Víctor M. Toledo and Alejandro Casas. Traditional agroforestry systems in Mexico: A biocultural approach. Botanical Sciences 91 (4): 375-398, 2013.

11 Although they are used on a small scale and *milperos* have learned to use them in a way that does not kill maize-associated crops: beans and squash, it is still not good for the health of *milperos*, soils and groundwater.

to be used, which often endanger family and environmental health, since they gradually reduce the genetic information of crops, their productivity, soil health and their connection with the renewable source of nutrients.

In the Maya Milpa, species with short-cycle variants are used, -which allow early harvests or harvests after the large maize harvest-, maize is very important for the major food, which is the *tortilla*. These cultivated phytogenetic resources have been important tools of milpa agriculture because they are permanently adapted through artificial selection of different soil and moisture conditions and to culinary and ritual demands (Terán and Rasmussen, 2008).

The biocultural practices that the milpa or *Kool* contributes to the conservation of the Maya Forest are, the construction of living fences known as *k'alche'* and the tolerance of large strips of tropical forest vegetation between 10- and 20-meters wide that border the cultivated plots or *t'olche'*, both with protection status within the local community regulations. The mature forest (*suhuy k'aax*) is cleared for planting by clearing shrubs, bushes, vines, weeds, and low branches of trees, followed by the felling of trees and larger shrubs, leaving the stumps at a height that favors rapid regeneration and protects some useful species through pruning and fire guards. The stage known as *Kool* describes a concept of migratory milpa (similar to the milpa among *Nahua* cultures). The last stage is called *ka'analkaax*, which is the fallow or long rest before being a mature forest or *suhuy k'aax* (Gabriela González-Cruz et. al.,2014).

The *t'olche*' has important functions in land delimitation as it has important resources such as wood for firewood and construction, as well as ritual and medicinal elements. It provides a structure that maintains the humidity to conserve the agroecosystem, where the strips of arboreal and shrub vegetation function to attract rain and infiltrate water. Thanks to the structure provided by the t*'olche'* and the stumps left at the time of the grave, there is a sped-up recovery of the vegetation when the plots are left to rest.

PURPLE COIN. PHOTO: GILBERTO M. GONZÁLEZ KUK

Secondary forests managed under the fallow system (slash-and-burn) are areas that harbor the greatest number of useful plant species, mainly herbs and medicinal shrubs, compared to mature forests and milpas. Secondary forests are also attractive spaces for their resource diversity for other animal species such as the wild turkey, deer, and peccary, which are highly valued for their culinary and medicinal uses. The complexity of the Maya strategy of multiple management based on silvicultural techniques is present in the milpa agroforestry systems and is part of other systems and techniques present in the Yucatecan Maya territory (See Figure 1 in III A.3.4).

The use of these resources has led to part of the productive diversity that characterizes the peninsular Maya system because it favors activities that have been a source of self-sufficiency and income, such as hunting and beekeeping. The production of lime and charcoal, getting firewood and plants for the construction of houses, utensils and handicrafts.

Some problems that faced Maya *milperos* have to do with the shortening of rest periods and the gradual loss of agroforestry practices such as live fences, isolated trees, vegetation borders, management of tolerated, promoted, or protected species, which together with the decrease in vegetation cover, the

increased using of agrochemicals and losing of specific crop varieties for the system, represent an important agroecological challenge that can promote socio-cultural transformations.

Other important problems are the loss of the traditional diet due to the substitution of junk food, which has repercussions on the loss of native seeds, traditional recipes and nutrition and health problems, and the generation gap that is opening between experienced *milperos* and young people, which is generating a loss of ecological knowledge and agricultural techniques.

2) Compared to the *Kool* milpa of the Maya Yucatecan, *Tlacolol* is a milpa system practiced in the mountainous territories of Guerrero, Michoacán, Oaxaca, and Morelos. In the regions known as Centro-Montaña and Montaña de Guerrero, it is practiced by *Nahua, Me'phaa* (Tlapaneco) and ñu savi (Mixtec) communities. Despite the differences in altitude (1400 to 2900 meters above sea level), climate[12] and vegetation[13], the soils in which the Tlacolol is developed are usually shallow and stony, (but not limestone as in the Maya milpa), but this characteristic is because they are on the slopes of the mountains.

In different modalities of the *Tlacolol* milpa, as in the Maya or *Kool* milpa, different varieties of maize are combined with bean and squash crops, besides alternating short periods of cultivation with long fallow periods that allow the recovery of vegetation and soil fertility. *Tlacololeros* tend to selectively leave some stumps and trees standing because they facilitate the recovery of vegetation and the propagation of plants valued for their uses and functions, as with *t'olche*' and *hubche*' resources. In these systems, agroforestry practices, use and management of bioculturally important plants have been recorded, and being traditional milpa systems, *Kool* and *Tlacolol* share the same problems related to fallow rest time.

Some problems that faced Maya *milperos* have to do with the shortening of rest periods and the gradual loss of

agroforestry practices

3) We are now going to look at another important agroforestry system that has been widely practiced by cultural groups in the Valley of Mexico, the Toluca Valley, southwestern Tlaxcala and the ecohydrological region of Campeche: The Chinampas. These are artificial plots usually located between 2000 and 2400 meters above sea level in semi-arid climates and clay soils.

These floating plots are rectangular with long, narrow islets, whose proportions allow them to capture the moisture from the ditches or canals where corn, amaranth, tomato, beans, squash, *chia*, *quelites*, chayote and *chilacayote* are grown, the milpa *polyculture* is planted with the three species always present (in addition to others that are traditional, but also new variants, including flowers). The *ahuejotes* (*Salix bonplandiana*) are important ecological resources of the chinampas because they are trees with soil retention functions, to keep the soil of the chinampas together so that the small floating islands are maintained.

Ahuejotes are also used as construction material and as fuel, their branches are used to cover the seedlings in winter and for the basket construction, and they are used as windbreaks and to break the movement patterns of insects considered pests.

12 Warm sub-humid and temperate climate, dominated mainly by tropical deciduous forest, and to a lesser extent, by oak and pine forests.

13 The leaf litter of the ropical deciduous forest provides material to maintain soil structure, at least compared to the sparse soil of the tropical dry forest.

Unlike the two types of milpa described above (*Kool* and *Tlacolol*), the *chinampas* are very fertile because of the organic soil that composes them and the constant access to water, which allows them to house a large number of crops that have been able to supply a high population. However, the increase of water lily causes ecological problems that contribute to the salinization of *chinampas* due to the drying up of lagoons and canals, the loss of agroforestry practices and forest cover, as well as the increase of agrochemicals and greenhouses in these sites. The urbanization of these areas is another process that threatens the permanence of these systems. In this socioecological panorama, the milpa of the *chinampero* system has little capacity for adaptation and resilience to abrupt climatic changes, compared to the Maya or *Kool* milpa, which develops in a wild and particular ecosystem, dominated by large extensions of native vegetation known as the biogeographic region of the Maya Forest.

4) Another agroforestry system practiced in Tlaxcala, Mexico state, Puebla, and Hidalgo is the *Metapantle*, which comprises growing strips of agave varieties interspersed with the polyculture milpa with maize, beans, squash, *quelites*, barley, *cempasúchil* and fruit trees. The *metapantle* is built on gently sloping hillsides, slightly changing the surface by building borders that are stabilized with plants to reduce erosion and absorb moisture. They are between 2580 and 2700 meters above sea level, in dry areas with long periods without rain and very low temperatures at some times of the year. The soils are predominantly clayey, somewhat deep moist, and slightly stony associated with *tepetate*. The *Metapantle* and the Maya milpa or *Kool* have been suggested by several authors as one element to define the respective regional biocultural area.

In economic terms, the *metapantle* is a system that supports the production of small farmers, since each hectare planted with *maguey pulquero* can produce ten tons of vegetable matter (dry basis) per year, with 60% fermentability, even when rainfall is 40 cm. However, the loss of maguey due to the clandestine extraction of *mixiote* makes the maguey vulnerable, and it dies quickly, which discourages its management, since for a plant to produce, it must wait eight years and thus, the loss of maguey management practices in the *metepantles* is evident.

5) Another SAF also practiced in Tlaxcala is the *Calal*, which comprises establishing narrow strips of land surrounded on all four sides by drainage ditches or canals. The construction of these canals involves the excavation of soil, which is placed on top of the land between the canals, resulting in elevated platforms for cultivation and a matrix of canals in the landscape. As with the *chinampas*, aquatic vegetation is also important in these systems. Important species include watercress (*Hydrocotyle ranunculoides* and *Nasturtium officinale*) and water palm (*Berula erecta*), which is medicinal and consumed as *quelite*.

Some species of tulle are used to make mats, tenates and hats and are a source of organic material that is stored in the canals. There is also a polyculture milpa with maize associated with squash and fruit trees such as *capulin* (*Prunus capulli*), peach (*Prunus japonica*), pear (*Pyrus communis*) and *tejocote* (*Crataequs mexicana*), which are on the edges of the plots and provide money for the families. Maize in this region has a six-month maturation cycle. In the past, there was a variant known as marceño, adapted to the humidity, which is no longer planted because it was affected by water contamination and ceased to be grown in the early 1970s.

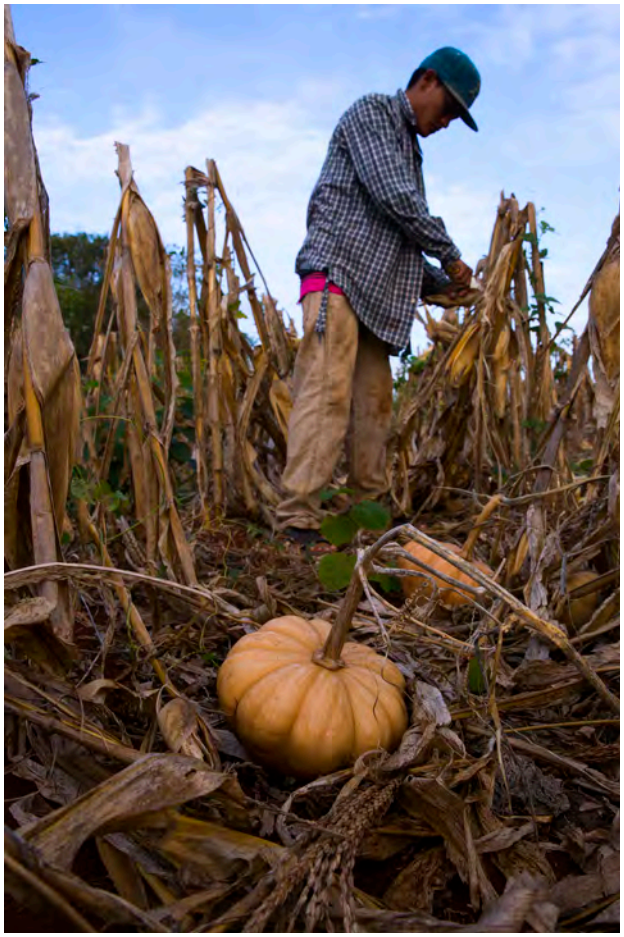
As the SAF *Calal* is transformed, these small, channels that mantained the humidity are being filled in to increase the cultivable area and to take advantage of machinery and trucks for agricultural activities, so the trees in these places are disappearing. It is SAF that is rapidly dying out due to processes associated with air, soil and vegetation pollution, pests, and the lack of labor force to maintain the system. In addition, as with the Maya milpa or *Kool*, the loss of knowledge, traditional management practices, and disputes over the political and economic control of land and water between communities, government and construction companies are processes that threaten these agroforestry systems, which are important for local/regional food security, ecosystem integrity and the defense of the territories.

6) Finally, we will briefly touch on an agroforestry system that is characterized by developing under a managed forest scheme where, in addition to cocoa, a high number of domesticated and wild plant and animal species, native and introduced species are maintained, imitating the structure of a forest, but with a high dominance of species useful to man in its composition.

Cacaotal is practiced in Yucatan, Tabasco, northeastern Oaxaca, central and southeastern Veracruz, southeastern Chiapas, and northeastern Guerrero. Cocoa plantations are in areas with a warm-humid climate and can be located up to 1200 meters above sea level, in deep well-drained soils, free of iron accumulations, with high nutrient content and rich in organic matter. The most important associated crops are coconut (*Gliricidia* sepium), pataxte (*Theobroma bicolor*), saman (*Pithecellobium saman*), mango (*Mangifera* indica) and moté (*Erythrina americana*). Studies have recorded the high diversity of tree species cultivated and managed in the cocoa plantations of Chiapas and Tabasco to shade the SAF.

The diversification of the *Cacaotal*, like any other SAF mentioned here, favors the household economy by obtaining several products for self-consumption and sale, thus reducing expenses and increasing income when the harvest ends. Additionally, planting timber species allows for a long-term investment as a family savings fund. The management of the production unit with biodiversity-friendly practices can generate other economic activities for the communities, such as associative nurseries, interpretive trails, seed sales and agro-turism or birdwatching, among others. Likewise, incorporating of these practices facilitates the path towards obtaining green certifications or can become an added value to increase sales prices in niche markets.

We see polyculture as the trademark of all the SAFs we have presented and in all of them, except in the cacao plantation, the milpa is present with its associated triad of maize, beans, and squash. This is important because it shows that the Mesoamerican milpa is not one, but many, and whose variants



MAYA MILPA. PHOTO: THE NATURE CONSERVANCY

each ecosystem and cultural requirements (culinary, ritual, and technical), which we have not delved into here, but which affect maize and other species that are favored. That is why we have emphasized the uniqueness of the Maya milpa and its importance for being distributed in the Yucatan Peninsula, where the second largest forest in America, after the Amazon, extends.

Despite the persistence of these traditional production systems and their agroecological, nutritional and cultural virtues, the abandonment of SAFs due to the monetization of the economy, the low price of their products (due to low quality, lack of certifications, etc.), the migration of the young population and the aging of the experienced farmers of these systems, as well as of the trees,

with the *Cacaotales* (approximately 25% of the cacao plantations in Tabasco are over 40 years old), are problems faced by the traditional production of the SAF.

The lack of disease and pest control has destructive effects on crops, which together with the loss of agroecological practices that promote water conservation and the use of natural fertilizers, exert a powerful pressure on traditional SAF. Despite the cultural similarities of the region in which the *Cacaotal* SAF and the Maya milpa or *Kool* are developed, the latter has resisted thanks to ecological limitations that have not favored large-scale extensive cattle ranching and extensive agriculture until recent years; the presence of biocultural practices and techniques associated with a continuum of vegetation that has allowed the Yucatecan Maya to transform the *Kool* milpa in the face of local and national systemic pressures.

We are witnesses of how the basis of Mesoamerican food, represented by traditional agroforestry systems in the nutritional triad (maize-beans-squash) that makes up the milpa polyculture, which has sustained generations, is ceasing to nourish families and territories due to the excessive use of agrochemicals and the considerable decrease in biocultural practices that was triggered by the advance of cattle ranching and industrial agriculture in different ways and in different areas, and that strips entire towns of goods, services, history and knowledge. Thus, and over and above other profound processes that we did not delve into, such as deculturalization, SAF goods under precarious production are not competitive in the market, particularly in globalized markets. In this scenario of constant change, the Maya milpa or *Kool* continues to contribute considerably to the Maya and multicultural agroecological system present in the communities of the Yucatan Peninsula.

MILPA TRIOLOGY. PHOTO: MARIGEL CAMPOS CAPETILLO

IV. CHARACTERISTICS OF THE SITE: GIAHS SELECTION CRITERIA

1. Food and Livelihood Security

IV. 1.1 Agricultural Production and Basic Structure of a Milpa

The peninsular Maya milpa cultivation system is formed by plants of the Mesoamerican triad: maize, beans, and squash as well as "Ibes", white broad beans (*Phaseolus lunatus L.*), which increases the core triad to four crops in Yucatan (Rodriguez, A., et al., 2016).

This agricultural food production system considers crop species that are nutritionally and ecologically complementary to each other; together they contain the nutrients needed to sustain the human body and the civilizations that have inhabited the Yucatan Peninsula (See Section IV. 1.2 Food and Livehood Security)

Besides the core species that are the heart of the milpa, there is a list of many other species that have been planted not only in the milpa itself but also in other agricultural areas such as the orchard (the *pach pakal*) and the plot, all of these are polycultures. In total, 32 species with 95 variants were recorded in 1994 in the community of Xocen in the east of Yucatan (Teran and Rasmussen, 2008). In 2020, Rosales and Cervera reported 100 variants for southern Yucatan, in the area where the Seed Keepers live (9 communities of 4 municipalities)[1]. This information does not mean that there has not been a seed erosion in the Yucatan Peninsula. It only means that there is enough diversity, at least in some parts of the Peninsula.

In the milpa polyculture, maize variants and other species are also planted in cycles (short and long) which allow crops to be sown and harvested at least twice a year. With good forest fertility, it was possible to cultivate the same space three and even four times a few years ago. It must be clarifies that the variants seed are of different cycle and cover areas that produces different volumes.

The milpa has been managed by slash-and-burn of vegetation in forests that develop in karstic conditions with erratic rainfall.

The milpa is the core of what we call the *milpero* system because it has developed an integral strategy to take advantage of the environment, so multiple agricultural and non-agricultural extraction and production activities have developed around the polyculture, to provide food security and get subsistence alternatives (Teran and Rasmussen, 1994; Rodriguez, A. et al, 2016). In bountiful years, many of these activities complement the milpa products, and in critical years, they have been fundamental.

Since the system depends on the forest, its conservation has been indispensable for *milperos*. Conservation derives into forest-friendly practices that are anchored in technical management and a ritual use.

Technical management is based on an indispensable and effective knowledge of meteorological phenomena and landscape characteristics. This is described in the knowledge section (See IV. 3.1). The cosmovision and ceremonies aresult from the relationship established with nature through the *milpero* management, and this has been essential to the existence of the system. This is described in the Culture section (See IV). Ecological knowledge that has been generated to implement the system is described in the second and third section of this chapter.

1 The Seed Keepers are a milpa organization that is dedicated to keep the native milpa variants (See section 3 of this Chapter). They reported more maize variants that in Xocen, because they are using not only native corn seeds but also some that were introduced from other parts of México and also some of them that are new variants as hybrid ones or selected by the *milperos* in association with agronomists as the Xoy-nal.

THE PENINSULAR MAYAN MILPA OF MEXICO CYCLE (KÓOL)

KÓOL IS A MAYAN WORD MEANING "TO PULL", AS IN ANCIENT TIMES TREE BRANCHES WERE PULLED TO CLEAR THE AREAS WHERE CROPS WERE ESTABLISHED.

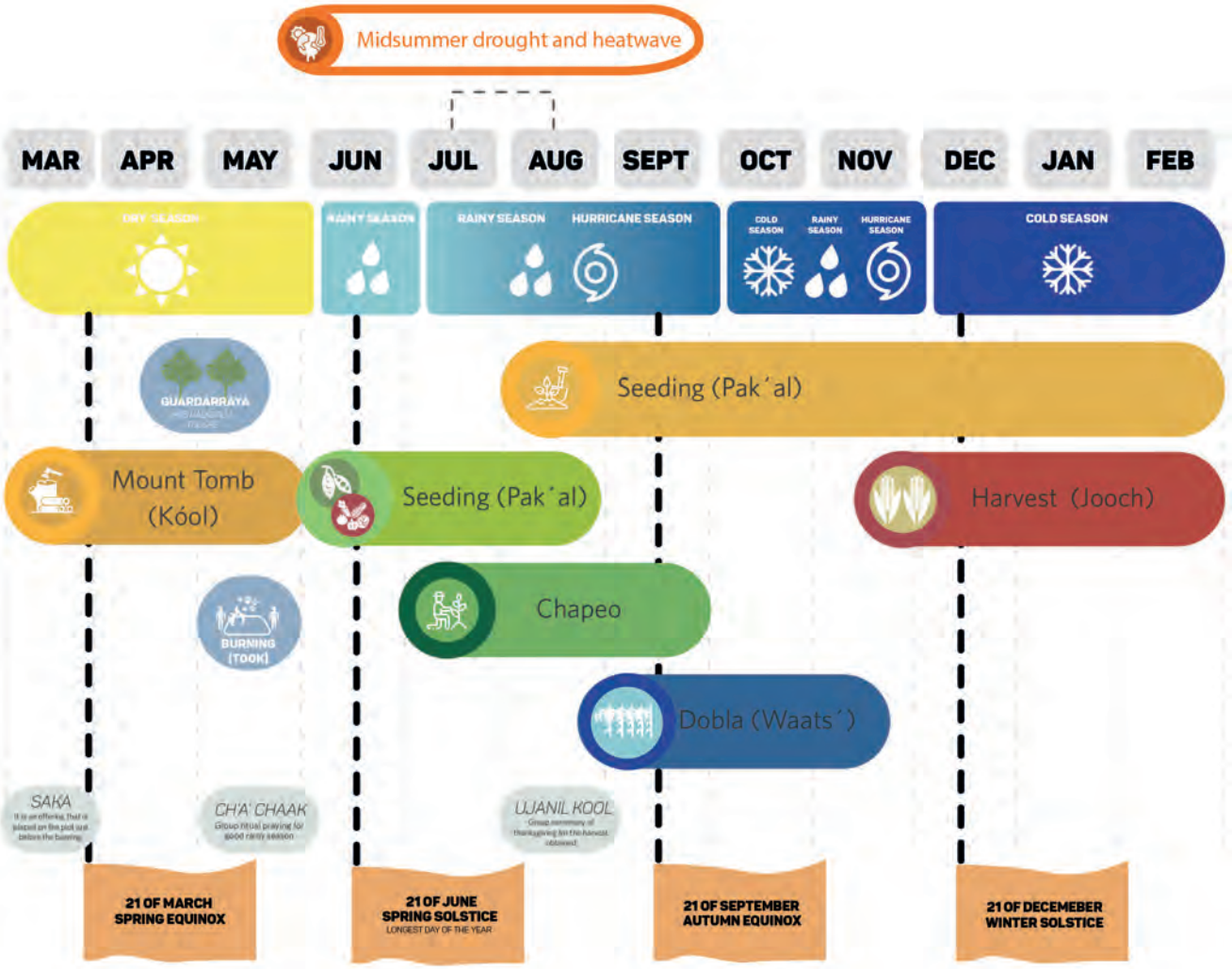


FIGURE 4. THE PENINSULA MAYA MILPA OF MEXICO CYCLE

IV.1.2. The Plot

Besides the production of milpa and the natural products that grow and are gathered in the bushes, the family garden "*Tankab*" or "*Kuch*" is the other essential productive and reproductive space for the *milperos*. A greater diversity of plants is grown in these home gardens than in the fields - about 524 species - in the Yucatan Peninsula. (Flores, S., 2012) Some are permanent, like trees and shrubs, and many are annuals.

Not only are plants cultivated, but animals are also raised. These areas cannot produce with yields as high as in the milpa, but they are usually next to family homes, and therefore receive daily maintenance, watered or fed, by the women. This increases the ability of the plants and cattle ranching to thrive.

For the milpa family, the plots are of enormous importance. When their milpas have a successful growing season, the food resources from the plots are a supplement to the harvest; but when the milpa is not as productive and successful - there are shortages - and the food and other products grown on the plots can be consumed and exchanged for them and / or for money.

In the plots, various agricultural processes are possible: planting and caring for trees and shrubs, cultivating small plots of short-cycle maize (such as *nal t'eel* and *xt'uup nal*), and producing vegetables and seedbeds. There are types of protected plots such as the *Kanché*, which consist of a soil bed arranged in a rustic wooden or woven platform with palm leaves underneath. It is suspended approximately one meter above ground level, in order to keep it out of reach of domestic animals, cattle ranching and pests. There is the *Kolosche'o'ob*, small areas with sticks or stones arranged around the plants to protect them from animal attacks. Plants are also cultivated in buckets, pots, jars and bags. The germination and care of certain useful herbs and medicinal plants is

CULTIVATION USING KANCHÉ TRADITIONAL TECHNICAL. PHOTO: HTTPS://JOURNALS.OPENEDITION.ORG/ELOHI/1154 RETRIEVED, AUG 2022

also carried out using this simple method.

Continuous, year-long cultivation, using boxes and bins to grow the plants, can technically be described as small-scale intensive polycultural. In the Yucatan peninsula, about 100 plant species are produced using this method.

The edible home garden is also a space for raising animals, mostly small domestic ones, such as chickens and turkeys, called *kax* and *úulum*, ducks called *kuuts ja'* and pigs called *k'ek'en*. Turkeys are of Mesoamerican origin, but some domesticated species were originally introduced to America by the Spanish conquerors. They were brought to Yucatan during the Colonial period, for trade with Asia. Over the centuries, Creole poultry populations, as well as other cattle ranching, developed and adapted well to the production conditions of the *milpero* system.

Raising animals on the plot provides highly nutritious food (meat and eggs) as well as other products; surplus food can be exchanged or traded for other goods and services. The Maya also use animals in their ceremonies and celebrations.

IV.1.3. Other Intensive Crops

In the Yucatan Peninsula, there are areas where better conditions and resources are found, compared to those found in other areas. They characterize as subsystems or technological variants of greater intensity. Below is a partial list:

- *Conucos* are temporary or seasonal edible home gardens on the western slopes of the *Sierrita de Ticul* (a low-elevation part of the Peninsula) They are set up to take advantage of the concentrated condensation from the

PIG IN PIGPEN IN THE MAYA SITE OF XOCEN, YUCATÂN. PHOTO: GILBERTO M. GONZÂLEZ KUK

morning dew; at this time of day, the soil can keep more moisture. “It is a system that can be used throughout the year, and it can sustain several crops, including up to three maize harvests and three annual cycles of vegetables, highlighting *meloncillo*, (cantaloupe) xpelón (a type of bean) white cucumber, watermelon, tomatoes, chilli peppers (including, *Habanero*, *Xcatic*, and Green), tsama beans. Soil depth is sufficient for tubers like cassava, sweet potato and *makal*. Another system is the milpa-hubche, in which the crops are planted where young scrub vegetation (under 6 years old) also grows. Finally, and notable for the infrequency of plots with the specific conditions, is the *Chachi-Pach*, a bean milpa that grows among tall brush that has never been burned. Recently, several of these *Chachi-Pach* have become diversified orchards. (Hernandez, 1992) “(Rodriguez, A. et al, 2016: 175-176).

- The seasonal use of *aakalches*, located in southern Yucatan and north-central Campeche, are characterized by clay soils. They are prone to cyclical flooding; if they have not been converted to intensive agriculture, they are used to cultivating short-cycle maize, *xmehenal*, and *cilantro* (coriander).

- The semi-permanent use of *Kankabales or Planadas*, which are also areas of deep clay soils with flat topography and few stones. They offer very favorable conditions for agriculture and, in these places, the practice of burning only occurs when the forest is being cleared; it is not burned again after this initial burning. The richness of this land allows continuous cultivation for many years.They are located specially in South Yucatan, Central Quintana Roo and South Central Campeche.

- The use of *rejolladas*, which are concave land formations or deep circular depressions in the land, are found mainly in eastern physiographic zones. They feature accumulations of topsoil that have been washed into rain depressions. As these circular depressions are closer to the groundwater levels, it provides them with a good moisture. Usually, fruit and other useful trees are grown in these areas. In pre-Hispanic times they were used to grow cocoa.

- Edible home gardens are planted mainly in flat fertile fields that have been cleared, but not burned. The soil in these spaces is moderately deep, with some small and medium-sized stones, and has good internal drainage. With these patches, the number of day laborers assigned to different tasks results in the high-intensity production (Rodriguez, A. et al, 2016: 176).

- These intensive crops are located in the south and east of the Yucatan Peninsula. In the Yucatan Plain there are only small *kankabales or planadas* scattered here and ther, as the last one described, and it is where the *pachpakal* or the seasonal milpa orchard is located.

- All edible and non-edible products derived from the system that contribute to the food and nutrition security of *milperos*. This includes plants, animals, forestry and aquatic products that are grown or collected in the system, as well as other products related to the wellbeing of the community, e.g., medicines.

The milpa polyculture generates the nutrients necessary for the human body, not only to survive, but to produce a civilization. Milpa sustained large populations, cities, art and knowledge specialists, not only in ancient Maya times, but in the colonial centuries, and in the independent Yucatan Peninsula, until the mid-20th century. This would not have been possible if the diet did not provide sufficient nutrients.

IV.1.4. Production volumes of the major

crops, their land productivity (e.g. yield per ha) and sales (expressed as economic values) of the mentioned products of the system, when available.

The average maize yields found are directly related to the reported age of the crop in the traditional milpa locality. Plots with low bushes which have rested for 5 to 7 years give a crop of 400-500 kg of maize / ha with the addition of fertilizers and with good weather; in medium bushes that have rested for 10 and 12 years, yields can range from 750 to 850 kg of maize / ha, and in high bushes, yields can be up to 1.250 kg of maize / ha. These milpas clear bushes for two consecutive annual cycles and then regenerate strewn ground. The study suggests that the predominant milpa in the Yucatan Peninsula is the one in the low bush (Rodriguez, A. et al, 2016: 53).

We have already mentioned that milpa production includes not only maize, but also the products of other crops. Forestry and wildlife also must be included. In this case, we report data for maize, beans, squash and ibes. Data from Arias (1995).

Milpa production comprises different products. In areas of 320 m2 the following yields are observed. Sweet potato 4 tons, chilli 505 kg, tomato 640 kg, and jicama 500 kg.

The fields outside the milpa have lower yields due to predator attacks that are controlled by rituals and hunting. There are differences in yield due to soil condition.

The yield calculation must consider what is consumed for the Pibinal (corn cooked underground that is offered at the first harvest and eaten while the corn is tender) and other products consumed during the first 15 days of maize harvesting.

Milpa production comprises diverse agricultural, forestry, cattle ranching and wildlife products that have exchange and use values, as well as the ability to provide additional monetary income.

Traditional production does not use chemical pest control, and yields have depended on erratic climate, *milpero's* knowledge and the socioeconomic possibilities of them.

- Size of land, forestry, grassland and other relevant agricultural resources exploited by the entire system and average size of a farm.

The size of cultivated land is usually measured in a traditional measure unit called mecate which is equivalent to 400 m2 (20 by 20 mt).

IV.1.5 Family Unit

The size of the milpa that a family can cultivate depends on its consumption needs and labor. These aspects depend on the age and gender of the family members, and the stage of family life.

- Labor structure in an average milpa is expressed as the number of workers and the sources of agricultural labor force (household, community, or external workers, etc.).

As we said before, the nuclear family is the economic unit that performs the different chores in the milpa, as well as its multiple productive activities; this is the strength of the system. The biological link creates a cell of great solidarity, cohesion, and social

MAIZE, BEAN AND PUMPKIN YIELDS (KG/HA).

Product	Milpa roza first year	Milpa caña second year
Maíz xnuknal	726.0	515.0
Xkoolibu'ul-ibes	400.0	60.0
Calabaza k'uum	200.0	177.5

and economic adaptability in the face of any crisis (Canul, 2016).

It is important to consider the account the number of producers and consumers that depend on the milpa.

The number and organization of the many family activities also have an impact, depending on the number, age, and gender of members (Teran and Rasmussen, 1994).

Although the nuclear family comprising father, mother, and children is the foundation of the family, the extended family comprising of aunts, uncles, cousins, and grandparents has been fundamental in family life because it is an important resource when additional labor is needed. Close family friends (compadrazgo) and other acquaintances are another potential labor resource.

- Average income of *milperos* (or household if this is more relevant), highlighting the contribution of the proposed agricultural system, as well as other income sources, under local life standards and aspirations.

For the development of this section information was available from a study conducted in six communities in the milpa region where the implemented method comes from: Social Accounting Matrix which shows the relationships between sectors and economic

MAYAN FAMILY. PHOTO: THE NATURE CONSERVANCY

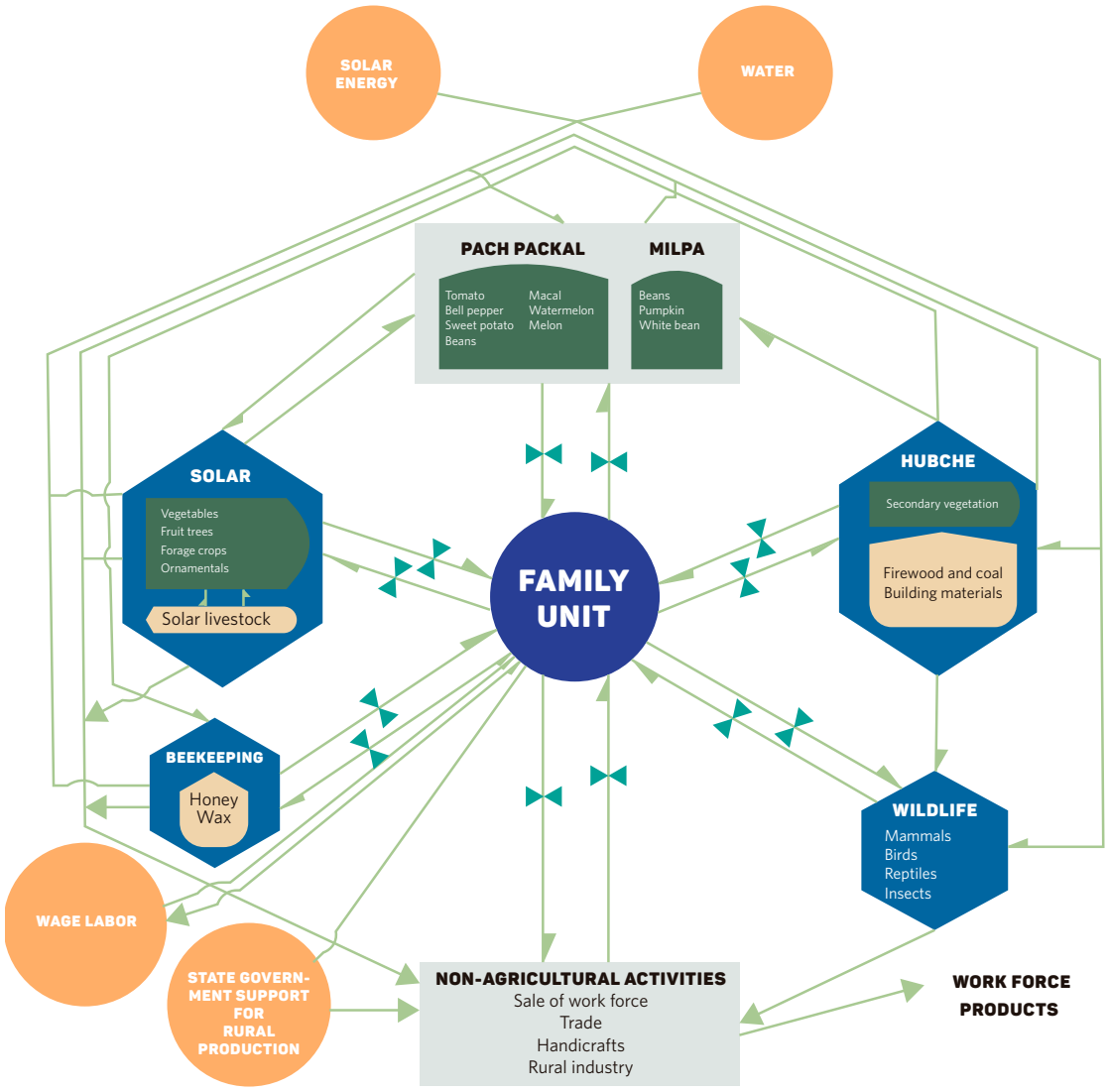


FIGURE 5. USUAL FAMILIAR PRODUCTIVE ACTIVITIES

SYMBOLOGY

- SOURCE ENERGY
- REGION
- PASSIVE STORAGE
- GREEN PLANTS
- RELATIONSHIP
- KEY, OPENS AND CLOSES THE FLOW ACCORDING TO THE FAMILY UNIT AND PRODUCTIVE ACTIVITIES

participants in each locality, as well as participants' income flows and expenses in the studied economy (Rodriguez, A. et al, 2016).

The analysis shows that monetary income sources differ across locations. According to the responses of

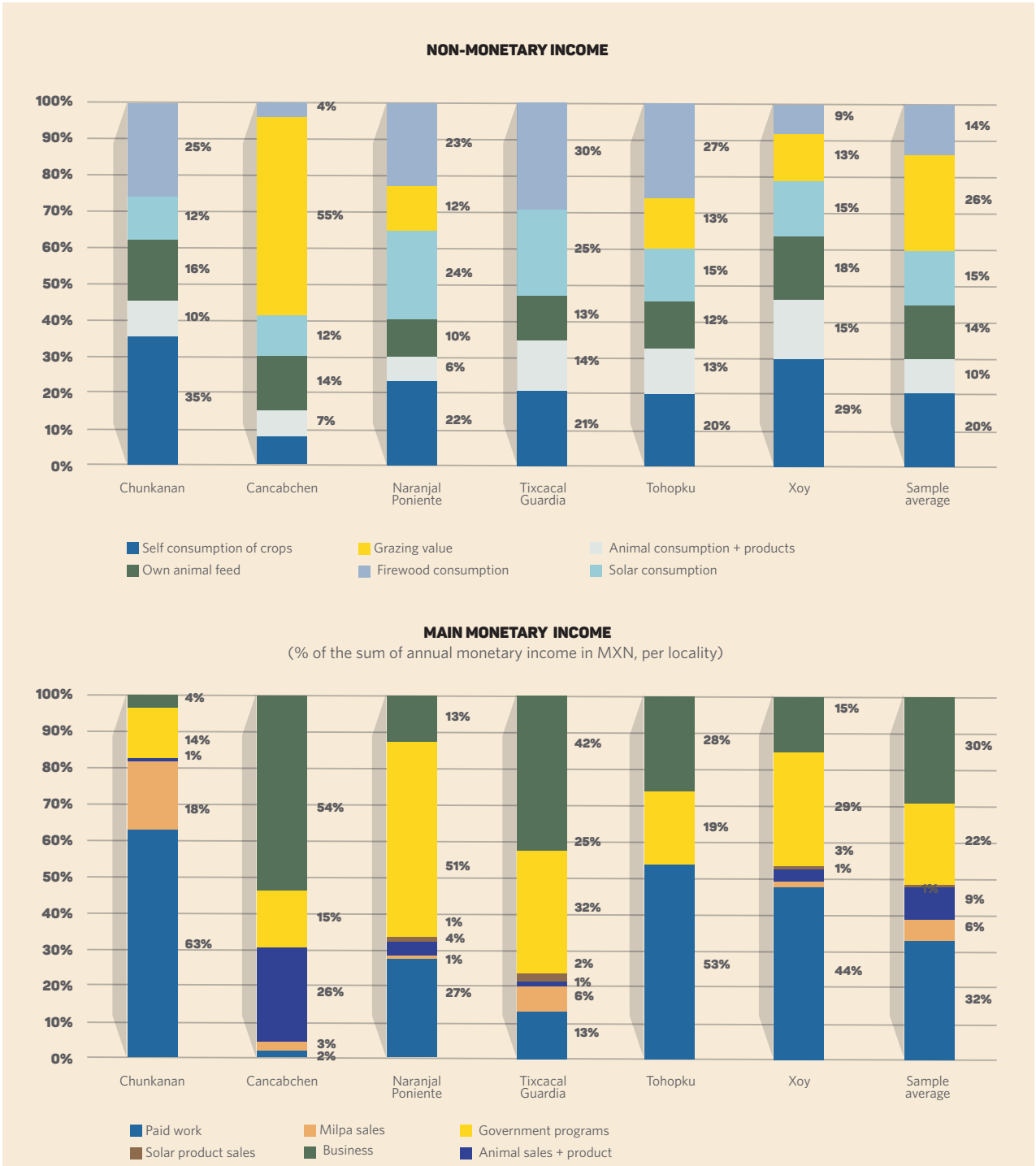


FIGURE 6. PERCENTAGE OF ANNUAL MONETARY AND NON-MONETARY INCOME BY LOCATION

the sample households, the results show that the income from wage labor plays a very important role on average. However, in the locality of Chunkanán, monetary income corresponds to 63% of total income, while in another locality, Cancabchen it amounts to only 2%. Other important sources are money transfers from government aid programs and businesses. Compared to the above, income from the sale of maize or milpa products is of lesser magnitude.

As non-monetary income sources, it is observed that on average one-fifth of the total income corresponds to the self-consumption of maize and about 15% represents the consumption of solar and wood energy, respectively. The percentage of maize or grass for animals' consumption represents 10% on average, and the equivalent value of grassland used for grazing corresponds to 26%. However, this is primarily affected by the high value in areas such as Cancabchen. The sites of study are indigenous rural communities, characterized by a high poverty rate, low education, limited infrastructure, few businesses and a lack of access to quality medical, financial, and banking services.

Regarding the productive income-generation of the localities, the milpa continues to be an important activity in the studied communities and in many others as well.

However, maize yields are very low and are decreasing further in climate change, and often the maize harvest does not cover *milperos*' consumption; this raises questions about the sustainability of the milpa system in its current form. From the above study, it is concluded that the milpa is not grown for its profitability, but also as part of the traditional culture and local customs. There is a clear tendency to supplement and/or substitute milpa planting with other types of activities, such as cattle ranching, beekeeping, horticulture, as well as changing systems that improve maize yields through mechanization, when conditions permit. A very important income source is wage labor outside the community, as well as money transfers from government aid programs. People who work for wages outside of the community

are the youngest members of the community. Only a low number of *milperos*' children engage in this activity. Thus, under current conditions, the next generations will not be interested in continuing to "do milpa". Therefore, the future of the milpa in the medium and long term is threatened, and to save this traditional system, the challenges inherent to the low yield of native corn, the new changes in climatic conditions, the abandonment of the traditional practice by the new generations, as well as the money transfers from government aid programs must be faced.

An important source of income is honey production. Since pre-Hispanic times and until the late 19th century, the país or xunan *kab bees*, as the melipona bee (*Melipona becheii Bennet*) is also called, and wild bees were the only source of honey and wax in the Yucatan Peninsula and were one of the principal tributes during colonial times (See chapter III part C).

In the mid-20th century, the introduction of the "Italian" bee (*A. mellifera ligustica*) into the *milpero* system, increased production because these bees have more productive qualities than the Yucatecan bees. The newly introduced bees adapted well to the peninsular conditions; the high availability of *melliferous flora* throughout the year and the ability of *milperos* to adapt their management style to a different species. These same conditions allowed the industry to face the challenges that occurred with the introduction of the African bee (A. *mellifera scutellata*) in the mid-1980s and transformed

TAJONAL FLOWER. PHOTO: THE NATURE CONSERVANCY

beekeeping into an even more productive, yet riskier, industry (Rodriguez, A. et. Al., 2016).

At present, the states of Yucatan and Campeche provide most of the honey that is exported. Production centers are scattered throughout the region's forests, and thousands of farmers, mainly *milperos*, take part in this activity. They all manage apiaries, usually composed of a few hives, and the honey they produce is taken to collection centers; they accumulate large volumes of honey, which is marketed by private and collective enterprises, mainly abroad[1]. (Guemes-Ricalde, Echazarreta-Gonzalez Villanueva according to -G, Pat-Fernández and Gómez-Alvarez, 2003).

In recent years the government and UNDP[2] are supporting women's groups of milpa families to produce *xunaaan kab honey*. This honey is very expensive because it is of high quality and has eye healing properties (15 grs. Usd 17.00 + 8.75 for envy honey Becheii in Amazon).

The major base for the high honey production in the Yucatan Peninsula is the presence of melliferous flora almost year-round (see section IV.3.2). This favors three or four well-defined crops a year, named after the outstanding flowering plants in each season.[3]

V.1.6 Agriculture, milpa surface, population, and the indigenous language of the Yucatan Peninsula of Mexico and in the proposed GIAHS.

The estimated area dedicated to agricultural activities in the Yucatan Peninsula is roughly 305, 000 hectares

1 This is a model of activity in the *milpero* system that is capable of being commercial that should be considered to generate alternative proposals to assist with monetary income and avoid labor migration.

2 UNDP-PNUD is supporting a Cooperative net called Kuxtalil, Yaalkaab with 96 women with 12 unities from 9 communities in the municipalities of Maní, Dzan, Oxkutzcab, Teabo, Chaksinkin and Tekax.

3 . The early blooming at the beginning of the year is called the "Tajonal" (Viguiera dentata), a predominant species in the area. It blooms after recent agricultural use and on the roadsides. The blossom of the "Tsi'silché" (Gymnopodium floribundum) which can be found in medium-dense deciduous forest, produces a highly appreciated honey because of the quality of its nectar; it blooms immediately after the Tajonal, but before the onset of the rainy season. Flowering trees (tsalam, catsím box, sak catsím), are found throughout the different deciduous and sub-deciduous forest; their flowers are abundant and attract the bees during the rainy season; and finally, the "Bejuco," lianas and other climbing plants (Convolvulaceae) are in flower during part of autumn and early winter. CRUPY report (Rodriguez, A. et al, 2016: 174-175).

of which 168,000 (55%) are destined to milpa production with 72,600 Maya *milpero* households in the Yucatan Peninsula that sum approximately 290,400 people, based on an average of four family members per household. Of these households, 15,600 (22%) are in Campeche, 38,000 (52%) belong to Yucatan and 19,000 (26%) are distributed in Quintana Roo.

Of the 168, 000 hectares corresponding to the peninsular milpa zone, 29% corresponds to Quintana Roo, 46% to Yucatan and 25% to Campeche, being Yucatan the state with the largest number of hectares destined to the milpa[1].

The following infographics show the milperas and milperos families in the three states of Yucatan, Campeche and Quintana Roo, who maintain subsistence agriculture through the Maya milpa, with their ancestral knowledge and millenary practices.

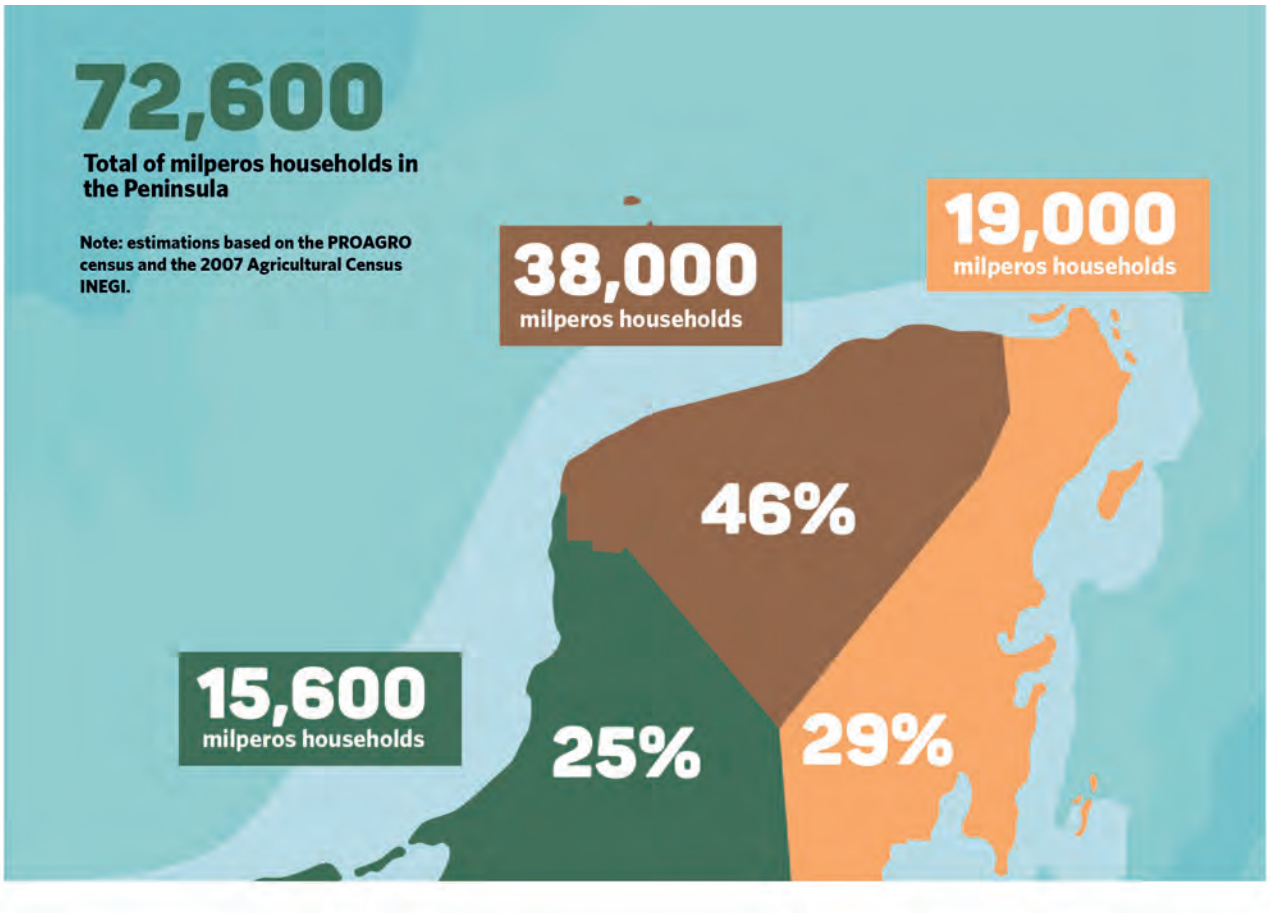


FIGURE 7. TOTAL OF MILPEROS HOUSEHOLDS IN THE PENINSULA OF YUCATAN

1 Although the Maya milpa is a complex and dynamic conglomerate as it has been presented, it is necessary to read and interpret it through figures that show its latent presence and current efforts of the populations and producers to keep it in existence. It is relevant to mention that, at national and peninsular level, data and information at municipal and local level is scarce and not so updated, given that the institutional programs and policies are limited in terms of equipment and resources to develop in-depth data surveys at community level. However, among the most updated and referential information platforms at the national level is the National Institute of Statistics and Geography (INEGI for its Spanish acronym), which through its various censuses and socio-demographic and economic activity counts, is the primary source of information..

It is worth mentioning that the data presented correspond to estimates made in 2007 based on INEGI's Agricultural Census (it is intended to update these infographics in the future).

FIGURE 8. AGRICULTURAL AND MILPA SURFACE OF THE YUCATAN PENINSULA. INFOGRAPHIC PRODUCED BY USAID, THE NATURE CONSERVANCY, RAINFOREST ALLIANCE, THE WOOD HOLE RESEARCH CENTER, NATURAL AREAS AND SUSTAINABLE DEVELOPMENT, AUTONOMOUS UNIVERSITY OF CHAPINGO.

a. As there is no specific census of the GIAHS core zone, the data reflect an estimate which we have approached based on information we have from the localities to which the signatories of the 3 states of the GIAHS proposal belong. Based on these data, we have projected averages to the localities of the 3 states that make up the core zone, and in that way, we have estimated the data presented in the table. We are aware that one of the tasks to be carried out if the certification to our Zone is approved, is to take censuses and apply other geospatial methodologies that allow us to precise the mentioned data.

Through a general perspective, we detonates the importance of this crop, not only as a reference in terms of subsistence agriculture but also as a cultural base in Mesoamerica associated with the Maya milpa.

Population Data in GIAHS Core Zone				
State	**Population**	**Indigenous population**	**Milperos**	**% milperos per state**
Yucatan	919, 673	388, 032	324, 105	75%
Campeche	100, 853	40, 559	29, 110	7%
Quintana Roo	129, 468	69, 480	79, 335	18%

Finally, it is commented that these estimates result from an initial and pioneering analysis for the GIAHS proposal, for future updates and research, it is intended to carry out fieldwork and construction of records linked to the delimited regionalization.

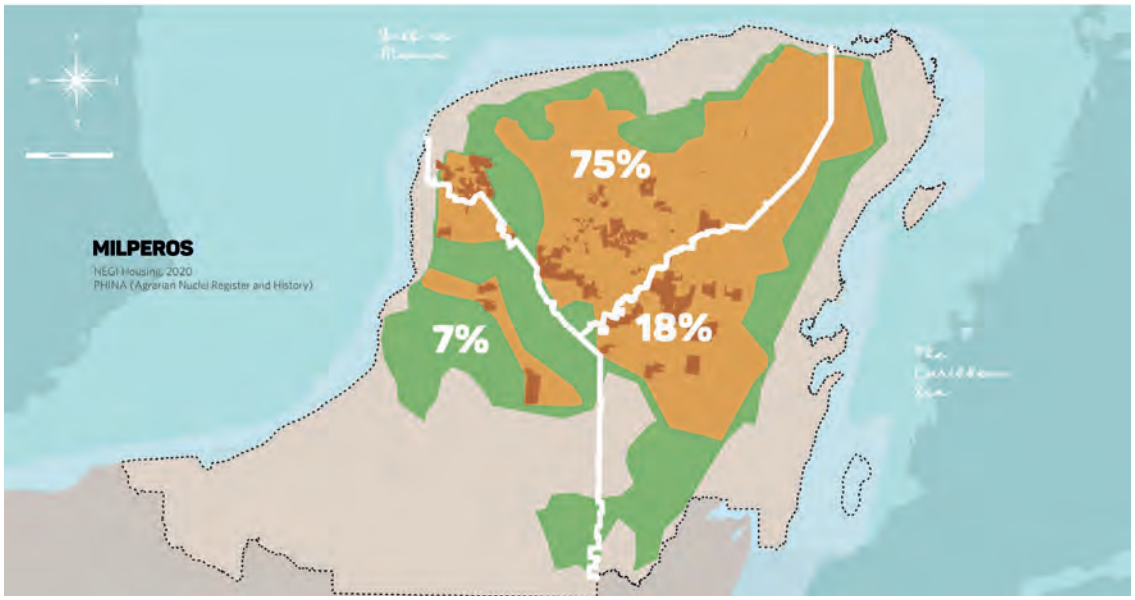


FIGURE 9. PERCENTAGE OF MILPEROS IN THE GIAHS CORE ZONE

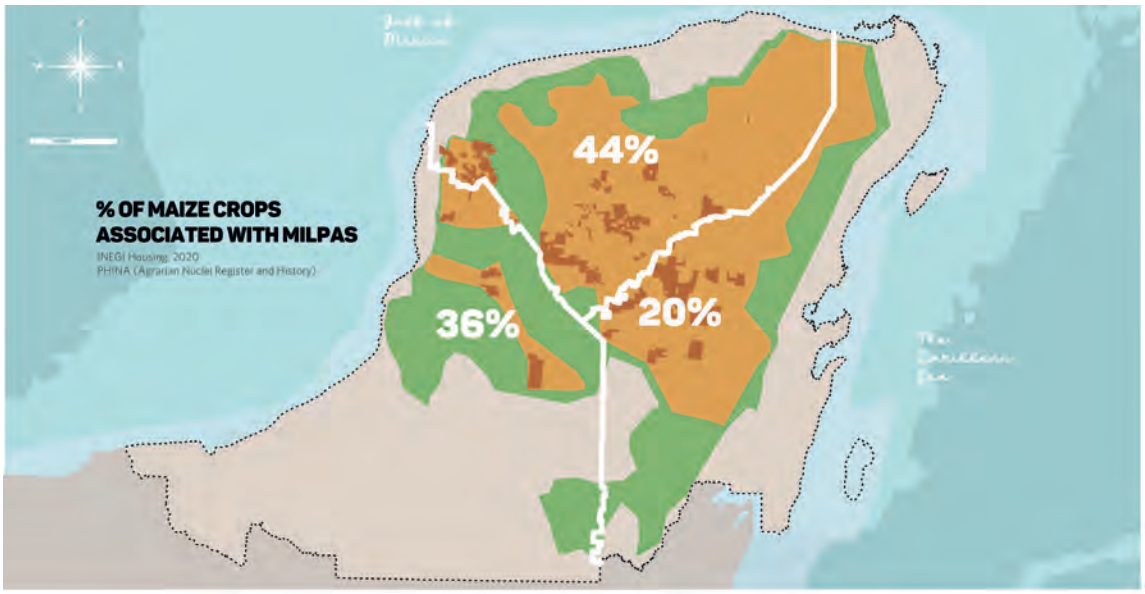


FIGURE 10. PERCENTAGE OF MAIZE CROPS ASSOCIATED WITH MILPAS IN THE CORE ZONE

IV 1.7. Food Security and Livelihood Security

Description of the extent to which agricultural production can ensure food security and livelihood security for *milperos*.

The main milpa crop is maize. The value of maize accounts for 45% of the value of the milpa. Associated crops account for 55% despite the decrease in species currently observed. These values do not include the value of the firewood, ecosystemic services and indirect forest use.

On average, two associated crops were identified per plot, the most common being beans, squash, and lima beans, occasionally followed by sweet potato, cassava, and cocoyam.

Native maize is used by 86% of producers with over 10 varieties. Each community has at least three different varieties of maize, including: Xnuknal, San Pableño, Sac tux, Xmehenal, nal Sac, Xtup nal, Tsit bacal, Nal xoy, Cuban, and others that are called Creoles or pais.

The following tables show the nutrients of various foods from the milpa polyculture:

NUTRIENT TABLE OF MILPA PRODUCTS

Bean, squash, turkey and rabbit nutrients per 100 grams of edible portion				
Food	**Energy**	**Proteins**	**Fat**	**Carbohydrates**
Bean	332	19.2	1.8	61.5
Squash seed	547	30.3	45.8	14.4
Turkey	268	20.1	20.2	0
Rabbit	159	20.4	8.	0

MINERALS AND VITAMINS TABLE OF MILPA PRODUCTS[1]

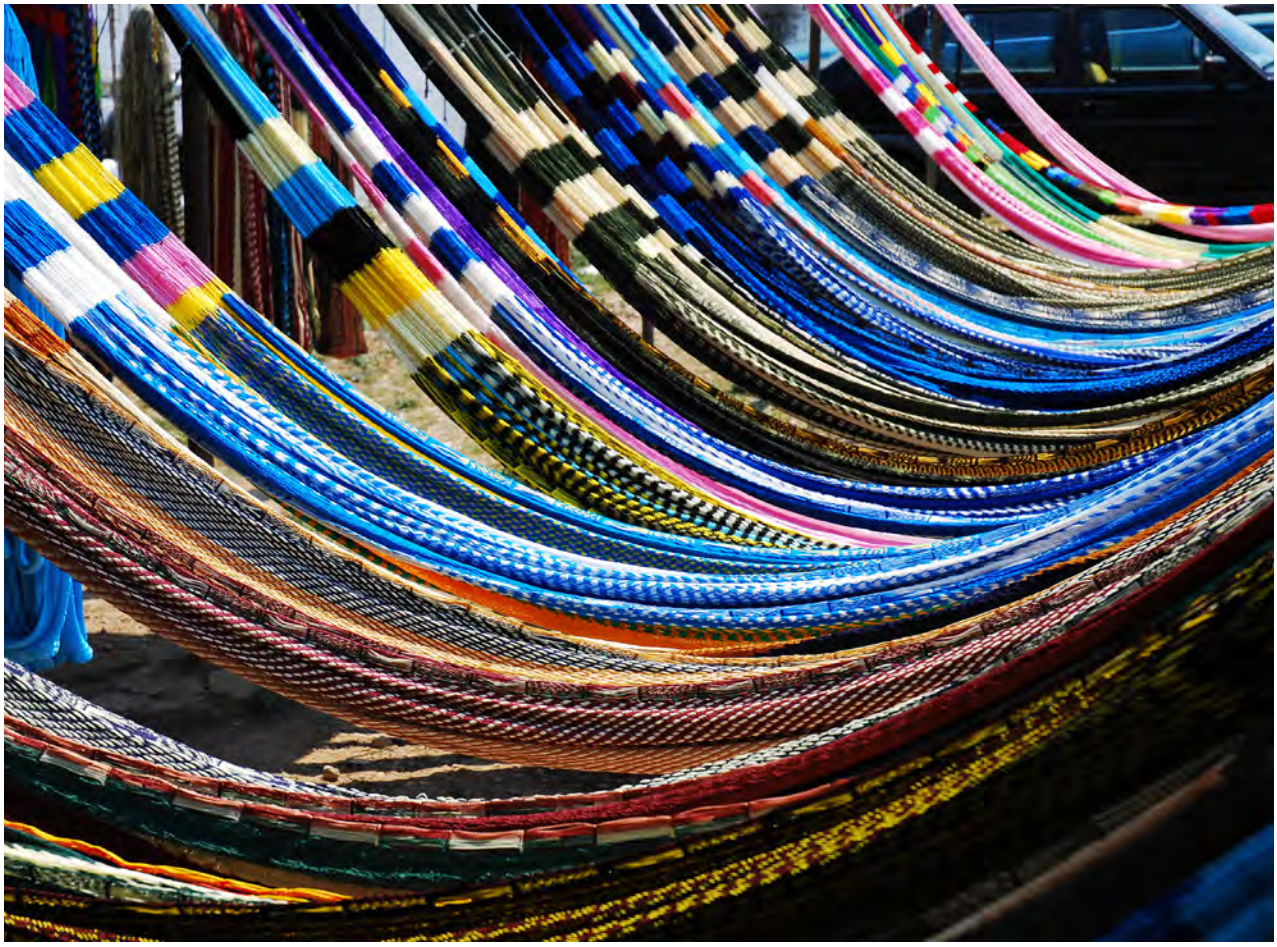
Mineral and vitamin content per 100 grams of edible portion "b" complex								
Food	**Ash g.**	**Calcium g.**	**Phosphoru g.**	**Vitami mcg. Eq.**	**Thiamin mg.**	**Riboflavin mg.**	**Niaci mg.**	**Vitamin C mg.**
Maize	1.2	22	268	17	0.36	0.12	1.7	0
Wheat	1.7	42	383	0	0.59	.12	4.4	0
Rice	1.2	24	221	0	0.29	0.05	1.6	0
Niztamal Flour	-	140	120	1	0.22	0.05	0.2	0
Wheat Flour	0.43	16	87	0	0.06	0.05	0.9	0
Bean	3.9	228	457	-	o.62	0.14	1.7	0
Zucchini	0.6	25	29	27	0.06	0.09	1.0	13
Fresh Chili	1.2	25	49	52	0.22	028	3.5	230
Tomato	0.5	13	27	507	0.07	0.05	0.8	17
Quelites	1.4	230	60	400	0.07	0.18	0.8	42
Squas seed	4.9	38	47	15	0.23	0.16	2.9	0
Turkey	1.0	10	212	80	0.09	o.14	8.0	0
Rabbit	1.0	18	352	0	0.18	0.18	10	0

- Degree of self-sufficiency and market inclusion: Degree of self-sufficiency or percentage of production sold to the market and the destination of *milpero*'s production.
- Role of other economic activities associated with the heritage system contributing to its conservation and development (e.g. tourism, agro-tourism, food markets handicrafts, clothes, etc.).

Handicrafts, especially embroidery and hammocks weaving, are products that have turned to the market. But also, activities that bring monetary income to the *milpero* household and that are traditionally produced as part of the milpa system, initially for self-consumption, but sometimes, for sale, have been increasingly developed for different markets.

Embroidery is a widespread craft, as traditionally all women learn this skill in order to make their own clothing. In addition, embroidery has traditionally been important in the strategy of the *milpero* family to get extra money when needed, but it also has been consumed by all social classes in Yucatan. Today it is produced by national and international tourists.

1 Data taken from Zorrilla, Leopoldo et. al., 1982:21



HAMMOCK. PHOTO: THE NATURE CONSERVANCY

Hammock production has been part of the family milpa economy and today is one of the principal products demanded by the touristic market. There are other products made of clay, sisal, or different palms that are offered to the tourist markets but they are not are as widespread as embroidery o hammock production.

Agrotourism, ecotourism and communitary tourism are activities that have been developed in recent years by several Maya communities. The Peninsular Alliance for Community Tourism, made up of 24 cooperatives from Campeche, Yucatan and Quintana Roo, includes communities that promote visits to milpas, plots, and to taste the Maya cuisine, as well as the handicrafts of Yucatan. There is a website where you can see the promotion of the communities that make up the Alliance. The Peninsular Alliance for Community Tourism. This alliance has been supported by researchers of the Autonomous University of Yucatan and from organizations as UNDP-PNUD and FONATUR (National Fund for Tourism).

Wage labor is another way for farming families to make money that allows them to buy goods they do not produce. Labor migration to the Riviera Maya (in hotels and in the construction industry), to the United States or to Mérida is an important way to bring money into the milpa family. But also, *milperos* work on other *milpero's* farms in their own communities or, when they can, in nearby towns and cities. Young men are the ones that migrate the most and women go to work as maids in homes or as servers in restaurants and hotels.

The inevitable monetization of the milpera economy drives the realization of activities that generate money.

Milpa agriculture must be seen with a view of self-sufficiency and direct the system to strengthen those activities that favor income and cultural identity, which are those that generate income within family agriculture, avoiding labor migration that erodes community and family ties, culture and the powerful ancestral knowledge for the sustainable management of biodiversity and the ecosystem.

IV 1.8 Contribution to the Sustainability and Resilience of the System

Highlighting the ability of the system to continuously provide food and livelihood security (e.g. how economic farm management contributes to the sustainability of the system).

In line with the Maya attitude of respect towards nature and their belief that they do not "own" the bounty found; hunting is subject to various local rules that are aimed at the responsible use of fauna (eg, not killing pregnant females), killing only what is necessary and showing appropriate respect for the Nature's deities; this is shown during the rituals in which permission is sought and thanks is given for hunting. Observance of laws and taboos is important; the *milperos* do not hunt unless when in need of food or in dire economic need (Santos-Fita, 2013).

There are many stories and tales about hunting, many of which revolve around the violation of the obligations we have to nature, or about the virtue of deer. Warnings, penalties, loss of life, or illness, for us it is clear that the messages in these stories have a very significant impact on wildlife resource management in a society that traditionally has not had institutional regulations to monitor its resources.

Several milpas practices have been identified, and according to their compatibility with milpa logic, sustainability and profitability have been adequate or good milpa practices. Many of them require a greater investment of labor, and others simply require a change in approach.

- Adapted to the milpa system (and largely derived from the system in its more traditional expression), each practice can be associated with at least one of the following principles:
- Compatible with the *milpero* system logic.
- Contributes to the restoration, diversification, preservation, or better management of the forest.
- Increases, improves, or maintains the diversity of plant resources

YUCATAN CENOTE. PHOTO: THE NATURE CONSERVANCY

FIGURE 11. BEST MILPA PRACTICES. PART OF AN INFOGRAPHIC PRODUCED BY USAID, THE NATURE CONSERVANCY, RAINFOREST ALLIANCE, THE WOODS HOLE RESEARCH CENTER, NATURAL AREAS AND SUSTAINABLE DEVELOPMENT, AUTONOMOUS UNIVERSITY OF CHAPINGO

used in the milpa

- Promotes increased overall production and, therefore, increased food security for milpa families.
- Strengthens or preserves collective forms of productive organization, rituals or other cultural manifestations which are linked to the milpa.

Good practices were grouped into six main areas and were graded for their climate effectiveness as high, low, or medium. These practices provide us with the important knowledge base we need to implement in a program that supports development of the peninsular Maya milpa. The results are:

The milpa has proven its resilience in multiple aspects. First, the system's basic technologies: polyculture and slash-and-burn technology are resilient. However, the system's resilience is also because of its productive and social diversity; it is associated with many productive activities that support families and the common good.

Polyculture is resilient because in the uncertainty generated by random rainfall patterns and thin, stony and nutrient-deficient soil, planting a variety of species that are adapted to different moisture, soil and topographic conditions ensures production.

Ongoing selection of polyculture seeds by milpero families is an activity that contributes to resilience. It helps them survive the ecological conditions of the area, satisfies their culinary and cultural needs, and increases their overall adaptability to minor climate changes. Each *milpero* constantly carries out artificial seed selection in his "laboratory" called "the milpa"; and each milpa family consistently evaluates the seed adaptability it has allocated through its artificial selection process. Each family ends up with a different gene pool that provides us with a diverse germplasm, which provides wealth and strength to this cultural heritage.

Collective ownership of seeds is another factor that promotes resilience because it favors the constant seed exchange and a gene-flow that strengthens the collective heritage at this level. If one *milpero* loses his harvest and seeds due to a disaster, a hurricane for example, the *milperos* who did not lose their seeds will share them with the one/s who suffered the loss, thus strengthening the resilience of the entire group.

The slash-and-burn of vegetation is a forest management technology that plays an important role in fertility, pest and weed control, conservation and biodiversity. Slash-and-burn of vegetation when preparing milpa fields for cultivation is a recurrent process, but prior to burn, "paths" (called Guardarrayas or Firebreaks) are created around the perimeter of the identified fields. In hurricane-prone areas, this promotes resilience, because when a hurricane occurs, strong winds knock down vegetation, and this creates favorable conditions for forest fires. The presence of milpas, and their practice of building firebreaks, results in reducing the devastating effects of spontaneous forest fires; because firebreaks not only stop the spread of milpa burning, but it prevents spontaneous forest fires from spreading to other areas.

The productive diversity of the milpa agricultural system is a resilience factor because not only does polyculture provide food and various resources needed for survival, but it also fosters the creation of other system components. The plots, located nearby the milpa families' homes, are one such component; these provide space for orchards, vegetable gardens, and the enclosures for domesticated animals, such as turkeys, pigs, and chickens. Hunting and beekeeping are two other complementary components that take place in the adjacent forest lands; these activities provide important sources of food. In addition, in the forest, firewood is collected, timber is available for construction, materials use to make utensils and tools are found, and medicinal plants are harvested. The forest also produces lye and charcoal. Clothing, furniture, tools and utensils for family use like handicrafts are also made to sell and earn income. Finally, small business activities and wage labor are sources of money for the household. The management and time allotted to the components are dictated by

the needs of the milpa. But they are all important parts of the system and provide security; because if the harvest is not good, due to drought, hurricanes pests and / or diseases, these activities will provide sustenance to the family.

Family and Community: Another Vital Pillar that Gives the Milpa System Great Resilience

The family is the driving force that moves the milpa system forward. It is adaptable and can withstand many crises (agricultural, economic, climatic, social) thanks to the unbreakable consistency of the bonds between its members. Being blood relatives, they are committed, flexible and open to exchanging roles. They all perform the variety of tasks necessary for the well-being of the family.

Finally, the consideration of the common good of the land and fields used for the milpa has given the system great resilience because the conservation of the system's biotic resources, on which the milpa depends, is the responsibility of all *milperos*, all families, and the community. For this reason, the privatization of the forest promoted since the modification of the Agrarian Law in 1982, has provoked its deforestation and the loss of biodiversity, although it has not been easy to change the Maya *milpero* mentality from common use to private use of the forest.

2. Agrobiodiversity

Describe the agro-biodiversity of the site, as defined by FAO (the variety of animals, plants and microorganisms that are used directly or indirectly for food and agriculture, including crops, cattle ranching, forestry and fisheries). The system should be endowed with globally significant biodiversity and genetic resources for food and agriculture (e.g. endemic, domesticated, rare, endangered species of crops and animals). A list of related agrobiodiversity and diversity elements should be included.

In this section, we will first address biodiversity and genetic resources related to domesticated plants that have been cultivated in Maya milpas (*k'ool*) and edible home gardens (*tankab*). Later we will write about wild resources that are related to food.

IV 2.1. Cultivated Plants, Reared Animals and Fish in the Proposed System

The Maya use of wildlife dates back to pre-Hispanic times and historically has been and continues to be very diverse. These uses include food, ritual, and medicine. Knowledge and use of wildlife are observed mainly in elderly men and women, and children.

This knowledge has been passed down orally from one generation to another, but is currently being lost among young people, as many of them are migrating to Cancun, Riviera Maya, Merida, and the United States in search of work. 81 terrestrial vertebrates were registered, including reptiles, birds, and mammals from 48 families and 21 taxonomic orders.

For over 3,500 years ago, the peninsular Maya population formed a set of basic genetic resources for food and agriculture, structured agroforestry, which are the material basis of their culture, one of the most developed in America. (Zizumbo et. al., 2010)

The peninsular Maya milpa comprises different crops, species, and varieties planted in a complex manner. Milpas are complex polycultural in which maize is visually predominant, but which flourishes with many other crops throughout the Yucatan Peninsula.

In the following table, it is highlighted the names, specific features and number of endemic and local varieties, and species with the origin of their genetic resource, when possible.

The species of the following table were incorporated or creolized over the years of existence of the milpa system. They come from other

Mesoamerican centers of domestication, (including maize, beans, and squash), from south America and other centers brought by the Spanish conquest in the 16th century (citrus fruits as orange, lemon and grapefruit).

NATIVE GENETIC RESOURCES FOR FOOD AND AGRICULTURE IN YUCATAN. ZIZUMBO V. ET. AL, 2010: 335

Scientific Name	Common name	Family
A. Fruit Trees		
Acrcomia mexicana	Coyol palm	Arecaceae
Bromelia pinguin	Piñuela	Bromeliaceae
Phyllanthus acidus	Country gooseberry	Malphigiaceae
Brysonima crassifolia	Golden spoon or nance	Malphigiaceae
Carica papaya	Papaya	Caricaceae
Casimiros tetramedia		Rutaceae
Cordia dedecandra		Boraginanaceae
Diospyros digyna	Black sapote	Ebenaceae
Hylocereus undatus	Dragon fruit	Cactaceae
Jacarantia mexicana	Bonete	Caricaceae
Malpighia glabra		Malphigiaceae
Manilkara zapota	Sapodilla	Sapotaseae
Parmentiera aculeata	Cucumber	Bignoniaceae
Pouteria campechiana	Egg fruit	Sapotaseae
Psidium guajava	Yellow guava	Myrtaceae
Sabal mexicana	Texas palmetto	Arecaceae
Sabal japa	Palm	Arecaceae
Spondias mombin	Plum	Anacardiacea
Spondias purpurea	Plum	Anacardiacea
Talisia olivaeformis	Guava	Sapindaceae
B. Grains and Seeds		
Brosimum alicastrum	Breadnut	Moraceae
Phaseolus lunatus	Lima bean	Fabaceae
Theobroma cacao	Cacao	Malvaceae
C. Roots and Tubers		
Parchyrhizus erosus	Jícama	Fabaceae
D. Vegetables		
Agave angustifolia	Caribbean Agave	Agavaceae
Agave fourcroydea	Henequen	Agavaceae

Scientific Name	Common name	Family
Cnidoscolus acontifolius var. Chayamansa	Chaya	Euphorbiaceae
E. Flavor and tint		
Pimenta dioica	Pepper	Myrtaceae
Vanilla planifolia	Vanilla	Orchidaceae
Capsicum annum	Chilli	Solanaceae
Capsicum frutesnces	Chilli	Solanaceae
Chenopodium ambrosioides	Epazote	Chenopodiaceae

INTRODUCED AND CREOLIZED GENETIC RESOURCES FOR FOOD AND AGRICULTURE IN YUCATAN. ZIZUMBO V. ET. AL, 2010: 336.

Scientific Name	Common name	Family
A.Fruit Trees		
Ananas comosus	Pineapple	Bromeliaceae
Anacardium occidentale	Cashew	Anacardiacea
Annona cherimola	Chirimoya	Annonaceae
Annona muricata	Soursop	Annonaceae
Annona purpuera	Purple anona	Annonaceae
Annona reticulada	Anona	Annonaceae
Annona squamosa	Sugar apples	Annonaceae
Casimiroa edulis	White sapote	Rutaceae
Citrus sinensis	Orange	Rutaceae
Citrus limon	Lime	Rutaceae
Citrus paradisi	Grapefruit	Rutaceae
Chysophyllum cainito	Caimito	Sapotaseae
Mammea americana	Mammee	Rutaceae
Meliococcus bijugatus	Spanish lime	Sapotaseae
Pasiflora edulis	Passion fruit	Gultiferas
Persea americana var. Americana	Avocado	Luraceae
Pouteria glomerata		Sapotaseae
Poteria sapota	Mammee	Sapotaseae

Scientific Name	Common name	Family
B. Grains and Seeds		
Arachis hypogaea	Peanut	Fabaceae
Cucurbita moschata	Squash	Cucurbitaceae
Cucurbita pepo	Squash	Cucurbitaceae
Cucurbita argyrosperma	Squash	Cucurbitaceae
Phaseolus vulgaris	Bean	Fabaceae
Zea mays	Corn	Poaceae
C. Roots and Tubers		
Ipomoea batatas	Sweet potato	Convolvulacea
Manihot esculenta	Yuca	Euphorbiaceae
Maranata arundinacea	Arrowroot	Marantaceae
Xanthosoma sagittifolium	Blue taro	Aranceae
D. Vegetables		
Solanum lycopersicum	Tomato	Solonaceae
Physalis philadelphia var. Domestica	Tomatillo	Solonaceae
Sechium edule	Mirliton squash	Cucurbitaceae
E. Flavor and Tint		
Bixa orellana	Achiote	Bixaceae
Capsicum chinense	Bonnet pepper	Solonaceae

Reared animals.

The Maya communities use a wide variety of plants that come from the forest, from secondary vegetation, from the milpa and from edible home gardens (Acosta et. al; 1998), using leaves, roots, the whole plant, fruits, seeds and shells to feed chickens, ducks, pigs, cows, horses, goats, turkeys, and dogs. A total of 192 species corresponding to 170 genera and 45 families have been registered. This contrasts with the 3 species of introduced grass that are used in cattle ranching areas. These plants should be promoted in cattle ranching programs to promote their sustainable management. Among forage crops, there are much nitrogen-fixing legumes that, for the same reason, are of significant benefit to the soil. (Flores G, J.S., 2010. p. 355) (See table in IV.3.2)

- Highlight the names, specific features and number of endemic and local varieties, and species with the origin of their genetic resource, when possible.

Intraspecific diversity refers to the result of selections that the Maya *milpero* has made over thousands of years, resulting in permanent or semi-permanent differentiations within specific genomes, with different names and forms.

Maize (*Zea mays)*

Remarkably, the existence of 4 races of maize breeds, all of them very characteristic of the Mayan milpa, and in order of importance, are named: 1) the Nal tel, 2) the Ts'iit-bakal, 3) the Xnuk nal, 4) the Xmejen nal. The "breed" that appears in the table with the name of "acriolladas", is not a breed in fact, but it groups maize that present morphological characteristics of other breeds that do not exist in Yucatan. There are more than 16 local varieties presumably used by mayan milperos; they are identified by the length of their cycle (short or long) and the morphological and color characteristics (Latournerie et al., 2006), (Zizumbo et. al. 2010).

MAIZE BREEDS IN YUCATAN AND THEIR LIFE CYCLE CHARACTERISTICS. ZIZUMBO ET. AL 2010: 337.

Breed	Cultivation cycle (in months)					
	1.75	2.5	2.5	3	3.5	4
Nal	K'an-nal					
	Sak-nal					
	Morado					
	Rojo					
Xmejen-nal		K'an-nal	K'an- nal			
		Sak-nal	Sak-nal			
			Sak-tux	Sac-tux		
Ts'it-bakal					K'an-nal	
					Sak-nal	
Xnuk-nal				K'an-nal	K'an -nal	K'an-nal
				Sak-nal	Sak-nal	Sak-nal
						Pix-cristo
						Xgranada-nal
						Xhe-jub(M)
						Xwob-nal
Creolized				Santa Rosa		
				Cubana (A)		
				Nal-xoy (B)		

Squash (*Cucurbita spp.*)

Variations within cucurbits are also worth noting. Terán, Rasmussen and May (1998) report 13 rural varieties derived from the three cucurbit species cultivated on the Peninsula: *argyrosperma C. moschata,* and *C. pepo*.

Wild populations of *C. lundeliana*, a possible parent of *C. moschata*, have virtually disappeared because of deforestation. Thanks to the wide genetic diversity of this species, it is still observed, although variants are disappearing (Colunga and Zizumbo, 1986; Colunga et al, 1996).

MORPHOTYPES OF SQUASH (*CUCURBITA MOSCHATA*) IN YUCATAN. ZIZUMBO ET. AL., 2010: 339

Life cycle	Skin thickness	Shape of the fruit	Color of the fruit
xmejen k'uum	Is k'uum	Jaya'ach k'uum o plato k'uum	Chay k'uum
(Short cycle)	(thin)	(Discoid)	(green)
Xnuk k'uum	Tok' sool	Kalis k'uum	K'an k'uum
(Long life cycle)	(Thick)	(Periform)	(yellow)
		Wool k'uum	Chak k'uum
		(spherical)	(red)
		K'atal k'uum	Ta'an pose'en k'uum
		(cilindrical)	(White-grey)
		Piña k'uum	
		(Elongated)	
		Trompo k'uum	
		(Conico)	

Lima Beans, ibes (*P. lunatus)*

Lima beans (known as *Ibes* in the peninsula) are the distinctive difference between the Maya milpa tetra-crop of maize-bean-squash-lima bean, and the Mesoamerican milpa with its triad. They also show a high diversity in wild and domesticated populations and gene-flow between domesticated populations and wild populations.

Twenty-five lima bean varieties have been recorded for this region, due to gene flow and farmer selection.

However, early variants are becoming extinct or show high rates of interbreeding with wild variants.

Deforestation due to cattle ranching and agricultural intensification is threatening the diversity of both wild and domesticated populations (Levy y Hernandez, 1989).

Among the most important native phytogenetic resources, 32 species are presented in the following table:

LIMA BEAN VARIANTS IN THE YUCATAN PENINSULA. ZIZUMBO ET. AL, 2010: 338.

Scientific name	Local variety	Relative abundance
P. lunatus var. lunatus (Ibe)	Mulicion	Abundant
	Sak	Abundant
	Puksik'al- tsutsuy	Common
	Nuk	Common
	Chak-saac	Common
	Mejen	Common
	Chak-petch	Rare
	Box-petch	Rare
	Ts'itsibal	Rare
	K'an	Rare
	Chak-mejen	Rare
	Matsa'-kitam	Rare
	Pool-santo	Rare
	Chak-uolis	Rare
	Chak-chi	
P.lunatus var. *Silvester*	Ib-cho	Comon
***P.vulgaris* (frijol comun)**	Kooli-bul	Abundant
	Tsama-bu'ul	Abundant
V. unguiculata	Xpelon	Abundant
V. umbellata	Frijol arroz	Rare

IV 2.2. Ecological Function of the Proposed System

- Highlight the beneficial relationship between species and ecosystem services provided by the agricultural system, including cultivated and associated agrobiodiversity.

Provision Services:

Among the most important provision services are: wildlife, forestry, energy, drinking water, and agricultural irrigation water. Services with a medium value considered are forage and medicinal provision.

Regulation Services:

Among the most important ecosystem regulation services provided by the Yucatan milpa zone are wind break, hydraulic gradient and carbon sequestration. It also has portions of medium and high importance in thermal maintenance, sediment trapping and water purification. It is considered moderately important in services as cyclone barrier drainage capacity, erosion control, and flood control. The state also has portions of medium, low and no importance in salt intrusion.

Support Services:

The milpa zone stands out for its high importance in wildlife habitat, geneplasm bank, oxygen production, aquifer recharge area, and microclimate control. It has zones of high and medium importance in providing services via organic matter detritus.

Cultural Attribute Services:

The milpa zone provides a service which is considered of high importance in relation to biodiversity; and it has zones of high and medium importance in providing landscape and recreation services and historical heritage.

- List of preserved species connected (wild relatives, plants, animals, microorganisms) to the system (e.g., forest management) highlighting threatened species/varieties and how the system contributes to their maintenance.
- Highlight the beneficial relationship between human activities related to GIAHS practices and biodiversity.

Positive Functions of the Maya Milpa Forest:

The forests of the Yucatan Peninsula (which reflect anthropogenic affectations, range from low deciduous forests of the northwest corner to the high evergreen forests of the southeastern portion; as well as medium sub-deciduous forests and sub-evergreen forests of the central portion, where the Maya milpa extends) constitute ecosystems well adapted to natural conditions, they have also supported human life which depends on them and its modification.

“In part, this occurs because of their natural capacity to reestablish themselves after the disturbances to which they are subjected, besides the practices that *milperos* ensure to facilitate their recovery. Regarding the regenerative capacity of the forests of the Yucatan Peninsula, there are recent data that place them as the forests with the highest regeneration density at the national level with values ranging between 4000 and 15000 saplings per hectare” (Rodriguez, A. et.al., 2016).

Environmental restrictions of land and precipitation limit the establishment of forest species propagated by seed, while forest species that are able of re-sprout after cutting and fire are the best propagated (Levy y Hernández, 1989), for this reason, we consider that the peninsular Maya milpa has been an important factor in the configuration of some features reported in continental vegetation (Rodriguez, A. et.al., 2016).

Similarly, both because of its own regenerative characteristics and human action to represent forest density (i.e., the number of species per unit area), the milpa zone is a conglomerate of patches with ranges varying between the categories of 50 to 100 and 101 to 200 species per hectare (Comisión Nacional Forestal, 2012).

BURNING OF A PLOT OF LAND AND GUARDRAIL. PHOTO: CHRISTIAN RASMUSSEN

These are some characteristics of the forests that the milpa has developed; these forests are, therefore, the result of the management that *milperos* have carried out for millennia. But the pressure exerted on them became too great, mainly because of the growth of cattle ranching and commercial agriculture. There are several reasons that man in these changed ecosystems has contributed to their preservation, through slash-and-burn management:

1. Controlled slash-and- burn reactivates biogeochemical cycles by renewing the soil and thus increasing the rate of carbon sequestration and N mineralization and nitrification.
2. Controlled slash-and-burn contributes to the prevention of large-scale disasters by regulating the volume of slow decomposition of dry organic matter through burning.
3. Controlled slash-and-burn reconstitutes the forest by modifying diversity.
4. Controlled slash-and-burn promotes wildlife (Rodriguez, A. et.al., 2016).

Positive environmental effects of slash and burn[1]

The slash and burn of small areas of vegetation for the establishment of the Maya milpa is an essential technological component of forest management with important positive effects on the environment:

1. **For crop nutrition in soils that are not very fertile,** by incorporating nutrients from the vegetation into the soil. In sites where the trunks and roots of large trees are burned to ashes, there is a greater nutrient concentration and horticultural or ornamental species are usually established there; similarly, sites where rustic ovens were built to get charcoal are also used.
2. **For the control of pests and weeds,** which disappear with the burning, including weed seeds. This situation favored, for millennia, an agriculture without agrochemicals that pollute the soil and

1 These aspects are developed in the proposal submitted (p. 20, 103, 104, 115, 116) in different parts of the text. Here we present them concentrated and summarized, although the description of the Slash and Burn technology is described more.

groundwater and endanger the producers and consumers health. By reducing the number of years of vegetation recovery, younger forests are slashed and burned, incorporating fewer nutrients and with limited effects in the elimination of pests and weeds, which has led to the use of agrochemicals;

3. **For biodiversity conservation,** by favoring fallow periods in which the vegetation and fauna of the milpa plots recover. The annual clearing and burning of tiny portions of the forest, which are worked for two or three years, results in a complex mosaic of forest fractions in different stages of succession, located in different soil types, which contributes to the greater richness of forest species.

4. **It has reduced the natural disturbance of the forest caused by recurrent hurricanes, which often result in large forest fires or prolonged droughts.** The controlled management of slash and burn vegetation in small areas scattered throughout the peninsular territory contributes to reduce the devastating effects of fires, because of the presence of the milpas and the previous elimination of part of the dry matter of the forests. This process has also helped the practice of forming guardrails around the milpas when they are going to be burned, so if there are fires in the forests or in the burned milpas, they cannot spread uncontrollably (Rodríguez, A. et.al., 2016).

5. **It has favored the regenerative capacity of the Yucatecan Forest,** by managing in a controlled and staggered manner tiny portions of land. Environmental restrictions in terms of soil and precipitation seem to limit the establishment of seed-propagated forest species and favor those forest species with regrowth capacity after slash and burn (Rodriguez et. al.). These develop from the stumps left at the time of slashing, which favor speed in succession and greater density (Levy y Hernandez,1989)

6. **Carbon sequestration is favored during forest renewal.** Although the high evergreen and evergreen forests are ecosystems that keep (sequester) a greater amount of carbon from their biogeochemical cycle than the medium evergreen and low deciduous forests, which are the predominant ones in the Yucatan peninsula because of their greater contribution to photosynthetic continuity throughout the year and to the long-term stability of carbon in the structure of the components of the former, the rate at which some processes of the cycle occur is higher in the latter, due to the considerable amount of organic matter involved in the production and loss of most of the foliage of the components of these ecosystems in a recurrent annual manner (Rodríguez, A. et.al., 2016).

Carbon sequestration is favored during forest renewal.

IV 2.3. Contribution of Agrobiodiversity to the Sustainability and Resilience of the System

This may include its contribution to climate change adaptation and mitigation, pollinators and environmental issues.

Milpero's experiences to conserve agrobiodiversity

Two important experiments are occurring in the Yucatecan fields among *milpero's* groups that need to be highlighted. These experiments allude to the awareness that is emerging among some residents in relation to the loss of native seeds, and actions being developed to avoid further losses. In the cycle-by-cycle planting.

Plant breeding efforts of the milperos farmers

For a little over 30 years, in the community of Xoy, and with the encouragement and support of a CRUPY agronomist, the *milperos* farmers experiment with the (participatory) improvement of their own maize. This has had some interesting results because they have already developed an improved variant, called nal xoy. This variant was developed collectively by several *milperos*. In recent years, this experience has spread to other communities, such as Chaksinkin, and now there are more and more *milperos* interested in improving maize. This is an important experience because it is being done together with the *milperos*, working from their agricultural logic, their needs and their culture.

Seed conservation efforts and seed exchange

Hurricane Isidore hit the Yucatan Peninsula in September 2002, and because of the seed loss that occurred across the peninsula; in 2003, seed exchanges between *milperos* began in four regions. They were assisted by several civil organizations[1] and academic institutions[2]. Farmers from the community where the improved maize nal xoy is produced also took part. The organization that finances these fairs is the United Nations Development Program through the Disaster Prevention Program. These fairs have been held for 13 years. The places where these exchanges have occurred are: north Bacalar in Quintana Roo (about 15 communities), Hopelchen, Campeche (about 14 communities), southern Yucatan (about 14 communities) and in the east of Yucatan (about 10 communities). Besides these fairs, other groups have also started seed exchange events, and are held regularly, such as those organized by CRUPY at their headquarters in Merida, the Organic Agriculture School of Peanut, and the Faculty of Agricultural Sciences of the Autonomous University of Yucatan, as well as the University of the east of Valladolid. Over 20 seed exchange events have been organized involving many communities and *milpero* farmers.

Finally, it applies to state that active *milpero* farmers have organized themselves as Seed Defense Committees or Seed Custodians Committees. All these committees have Maya names and although it is a new practice, it is carried out according to their cultural rules and ancestral cosmovision, so that every time a community exchanges seeds, a ceremony is held.

IV 2.4. Treats and Challenges

One challenge being experienced is the loss of agricultural diversity and threats. Unfortunately, government public policies and programs based on the idea of alleged productivity that does not consider sustainability and food security, are displacing the creole.

With maize, commercial agriculture introduces improved variants with higher grain production, but that are highly susceptible to pests and displace the pre-Hispanic nal tel variant which has been around

1 Civil society organizations participating are Education, Culture and Ecology, EDUCE BC Hombre sobre Tierra HST AC and Missionaries MAC A.C.

2 The academic institutions involved are the University Regional Center Yucatan Peninsula CRUPY of the Autonomous University of Chapingo, the Center for Research and Advanced Studies CINVESTAV National Polytechnic Institute IPN.

for 2,500 years old at least. *Nal tel* maize has several advantages: earliness that favors several annual crops; genetic incompatibility with perennial teosinte that limits the potential escape of transgene,

long bracts that completely protect the cob from pests and allow the plant to be stored, pest-resistant grains which allow storage, and high resistance to phytoplasm that is very common in the tropics. All these characteristics are important for breeding. (Zizumbo et. Al., 2010)

Zizumbo reports that the loss of agricultural diversity has reached over 80%. (Zizumbo et al, 2010. 334). All this seriously jeopardizes the sustainability of agricultural systems and food security and sovereignty.

Loss of agricultural diversity has also endangered the health of the population. The state of Yucatan ranks high nationally in malnutrition, obesity and diabetes and is the state with the highest incidence of childhood obesity. The changes on the milpa diet are one of the effect of the genetic erosion.

Despite the situation described by Zizumbo, there is still great diversity in at least some parts of Yucatan, which improves the chances of a recovery program. Agriculture microhabitat and multi-technology established the ancient Maya in forested areas of the Yucatan peninsula region remains a viable option, a solution to current agricultural development. The Maya recognized the importance of diversified agricultural resources and flora and fauna, besides marine resources, taking advantage of them for socioeconomic development. The current agrobiodiversity includes over 160 species grown and harvested, over 40 species of animals and over 600 species of medicinal herbs. An agroforestry management. These different species have been the natural resource base on which production and social reproduction of the Maya people is based.

The current agrobiodiversity includes

160 SPECIES GROWN AND HARVESTED

40 SPECIES OF ANIMALS

600 SPECIES OF MEDICINAL HERBS

3. Peninsular Maya Local and Traditional Knowledge System

A description is made about the current status of invaluable peninsular Maya traditional knowledge, that includes ingenious adaptive technologies and management systems for natural resources, including biota, land and water.

The relationship that has existed between man and nature for the last 3,500 years in the Yucatan Peninsula has led the Maya culture to gather indispensable knowledge about the regularities, peculiarities, and anomalies of the environment, its resources, and the most effective ways to use them to sustain life (Rodriguez, A. et.al., 2016).

This traditional knowledge system has been sheltered, transmitted, tested,

and modified as it is used during each crop cycle. Traditional knowledge has been orally preserved and interacts with the real and supernatural realms that make up the peninsular Maya cosmovision.

The traditional knowledge developed by the peninsular Maya *milperos* can be grouped into two main categories: 1) that related to the characteristics and components of the environment (climate, land, soils, plants and animals), and 2) the implicit knowledge of practices, both for their execution (how they should be conducted), and their relevance and effectiveness (why and under what conditions they are performed). It should be noted that the key technology that has been the annual artificial selection of cultivated plants - particularly maize - would not be possible without detailed ecological knowledge of the forest.

Knowledge has an eminently technological connotation because its implementation implies the application of knowledge to achieve a purpose, i.e.: site selection and preparation, conditions for planting, control of competing vegetation, cultivation techniques, harvesting, etc. This knowledge can be grouped into the labor process category. The other grouping is composed of different processes and practices that help to use the milpa system, such as hunting, beekeeping, gathering wood for fuel, obtaining wood and other materials for construction, production of charcoal, and cattle ranching rangeland (Rodriguez, A. et.al., 2016: 217-218).

IV 3.1. Traditional Knowledge, Practices and Technologies Highlighting Unique Characteristics of the Peninsular Maya Milpa System

Classification systems have been identified for climate, land, vegetation, and soils which reflect the impressive knowledge that the Maya have traditionally had about their environment, and which has been indispensable for agriculture.

Among Maya *milperos*, there are two ways of referring to the land. The first one, the land, is named for its topographic location along with the types of soils, its related moisture conditions, as well as to its plant cover. Another way of knowing and establishing criteria about the land is through the sequence of plant succession, identifying different seral communities depending on the time of the disturbance. The ecological variables used by the Maya to monitor and describe this process are plant community composition, plant community structure, vegetation height, presence of key plant species, age and disturbance history, and their interaction with local fauna (Gonzáles Cruz et. Al., 2014).

"One of the richest and most complex fields of Maya knowledge is related to soil. The great topographic diversity, the occurrence of related phenomena and the millenary impact of physical and biotic elements have led to a reticular or mosaic distribution of somewhat extensive patches of different soil types across the geography of the Maya milpa" (Rodriguez, A. et.al., 2016). It has been the object of knowledge of Maya *milpero* because of its importance in their daily activities.

To survive in such a rocky place and with so little soil, it is very important to know in depth each space where it is possible to cultivate. To give you an idea of this knowledgement please consult the five tables attached at the end of this document where you can see different classifications from the south of Yucatan, which is where there is the greatest diversity of soils because the topography is more complex due to the presence of higher and older hills. Table 13 shows the soils that designate the hills of southern Yucatan. Table 14 refers to categories that classify physiognomic features of southern soils. Table 15 reflects categories describing morphological features of southern soils. Table 16 describes properties of southern soils and finally Table 17 refers to soil quality categories.

Detailed and useful information about weather is derived from cloud and rain typologies, as those recorded in propitiatory ceremonies. Terán and Rasmussen (2008) have found in a rain ceremony in Xocen, Yucatan, the rogation to 16 gods and goddesses to make it rain, but whose names are

descriptions of different rains and clouds forming an important typology containing a deep and guiding knowledge for agriculture, of these phenomena.(See tables 9 and 10)

- Genetic Material Selection, Conservation and Propagation Management Highlighting Peninsular Maya *Milpero's* Agrobiodiversity and Management Practices

"Since the milpa is an agricultural system framed in highly limiting ecological conditions for the control of humidity and soil fertility, as the control of competition, pests, diseases and predation; the central strategy to ensure production could not rely on major modifications to the environment that are not workable, but on major modifications to the germplasm, to count on polyculture systems, in which each species presents different variants of a broad genetic base that allow the adaptation of the productive system to the high variability of the rainfall regime, to a mosaic of soil conditions, as pests, diseases and the competition present. This wide variability has also been focused on the adaptation of production to the socio-economic conditions in which the system has developed, in which there are still great limitations in the storage of products and few facilities for supplying the population with outside satisfiers, so that in this sense the farmer also seeks a wide variability (of products) that allow him to satisfy the whole range of his basic needs. Thus, the management of genetic resources has made up for the farmer one of the central tools to face the amplitudes and limitations of the ecosystems he manages and the socio-economic conditions in which he is located, and based on this tool to get his satisfactions, which include both those necessary for self-consumption, as for obtaining surpluses" (Colunga and May, 1991).

The preparation of the seeds for planting includes two aspects: 1) obtaining, selecting, and shelling the maize, which will be used; and 2) collecting and preparing seeds of associated crops (*xaak'* in Maya), which is the set of seeds that accompany the maize and are sown in the same area.

As it is customary to keep the cobs wrapped in their

leaves (joloch)

last year's cobs are shelled

Selection of maize.

Maize from the previous crop is used or bought. Many have inherited grains from their parents or relatives, although sometimes they are exchanged for grains that are considered more suitable to their needs (healthier, higher yielders or more useful for certain consumer purposes). The maize to be planted is stored in warehouses protected with bleach or insecticide. In recent years, seed fairs organized by milperos or other organizations have become places to obtain seeds.

As it is customary to keep the cobs wrapped in their leaves *(joloch)*, last year's cobs are shelled. Two-year-old maize is no good because "its heart has died". The kernel must be crystalline, which shows that its heart is not dead. The kernels in the center of the cob are selected and those at the end are discarded. Some years, when milpas are hit by hurricanes, this forces *milperos* to use smaller cobs, even though they produce a p'ex, or thin, maize.

Selection of other Seeds:

Recado or Xaak'.

The diversity of *xaak'* depends, on the one hand, on the seeds that the *milpero* has, buys or likes, and on the fertility and characteristics of the soil. The xaak'o is made from the associated seeds that accompany the corn in the same pot: beans and squash.

- Production management including pollination practices, training methods, crop and breed management describing all practices, related knowledge, and the knowledge of the soil and the soil itself, is the basis of the *xaak'* diversity.

A MAN CLEARING THE LAND. PHOTO: GILBERTO M. GONZÁLEZ KUK

Practices of the Milpero Process

Prior to planting, a set of management practices carried out to establish a well-defined agricultural production cycle.

The selection of the land to be used to establish a new milpa can be done from July to April. This task takes a day at most.

Once the land is selected, a path is cleared around the selected area with a machete or hoe. This area can be rectangular or square.

The area is then measured and divided into sections (called *mecates*) with rope. This defines the amount of land to be worked and is used to organize it. In the 1980s, milpas were recorded measuring between 2.5 and 3 hectares, divided into 50 - 75 mecates. In Yaxcabá, milpas were recorded as measuring between 2 and 6 hectares (Pérez, 2013). An adult could tend approximately one hectare. An average of 1 to 3 hectares per milpa. (Rodriguez, A. et. al., 2016).

Clearing the land is a labor-intensive procedure. Working hours and the instruments used for this practice vary according to the particular conditions of the land, the arboreal cover, or the time of the year. It is not the same to clear high, medium, or low vegetation or a milpa in its 2nd and 3rd year. Nor is clearing high vegetation in August the same as clearing high vegetation in March.

The holes are dug with the help of a *xuul*, (a stick with a sharpened tip that is protected with a metallic cover). Four to six grains of maize are used per hole, or seven if the land is good. The holes are made 0.80 - 1 m apart and have a depth of 8 - 10 cm. They use many seeds, so there is enough “for the gophers and birds”.

SOWING WITH A *XUUL* OR PLANTING STICK. THE SEEDS ARE CARRIED IN THE *MILPERO'S* SABUCAN. PHOTO: GILBERTO M. GONZÂLEZ KUK

Many *milperos* offer sak'a or sacred pozole when sowing, to ask God to grant the caregivers of the land permission to remove their animals away from their milpas and take them elsewhere.

As the milpa is distinguished by being a polyculture, its sowing includes not only maize but many other associated species and varieties and the pet pach pach pak'al, the milpa vegetable that grows where they find a patch of soil without stones and with more soil. It also includes a diversity of maizes. Finally, the diversity and volume of crops increases with the number of milpas managed within an agricultural cycle, as discussed below.

The most important crop is the *xnuk nal* maize, which has a long cycle. However, other crops are also planted that have different cycles and planting times. There have been three planting and replanting periods, Terán and Rasmussen, (1994):

1. Planting takes place in April: small maize and other seeds, mainly cucurbits.

With the first rains in April, planting of short-cycle maize or *xmejen nal* begins. Most variants of the short-cycle, *xmejen nal* variants, are planted in plots or in milpas near the town, but the intermediate variants are also grown in the milpas.

In addition, other plants like melon (*Cucumis melo L.*), cucumber (*Cucumis satirus L.*), watermelon (*Citrullus lunatus Thumb Matsumura* and *Nakai*) and some root vegetables like sweet potatoes are planted in April.

MAN SOWING.PHOTO: THE NATURE CONSERVANCY

The *ak'il makal* (*Dioscorea alata L.*), or purple yam, is sown in March or April. Yuca (*Manihot esculenta Crantz*) or *ts'iim*, is sown in April or May. Roots and tubers are planted in 1st year milpas, between maize; and some of them, the following year form a pet pach and can be farmed without the maize.

2. May-July plantings: large corn, associated, inter-cropped and in pet pach or groups. Let's remember that before planting, the corn and associated plants are selected, a process that, due to its importance, is described in previous pages as an important practice.

May plantings are the most important because they include large corn and the largest spaces for *milperos*. They occupy most of the sown land, including the milpas that are in their 1st, 2nd and 3rd year.

Along with maize, other variants are planted: xaak or recado (legumes), hot peppers, tomato, or the small spelt bean *tsuk xpeeron* (*Vigna umguiculata L.*), which is usually grouped in pet pach plantings. The *xmejen bu 'ul* and *xwach bu'ul*, are small beans that are also planted in May. The *xt'oop* seed, or *coarse* seed, is also sown and is usually planted throughout the milpa, alternating with the large maize.

3. Planting is done in August-September: jicama and *tsamá* beans.

In August, jicama and a second harvest of *tsuk xpeeron* are sown in advance, in order to harvest in October-November for the food of the dead or *janal pixaan*.

Whatever corn is missing due to drought and/or animal attacks in all the milpas (1st, 2nd and 3rd year), is replanted. This begins in June, especially since it is almost always done three weeks after it was sown for the first time.

Small areas within milpas are managed differently. This space (the '*pet pach*' or *´pachpakal*') is the seasonal edible home gardens of the milpa and receives particular management. Crops are sown separate from maize because the shade cast by maize can harm them. These spaces are small, measuring only between 0.5 to 1 mecate. Other crops can be planted between the maize, not packed, but scattered, so that one does not hinder the other's growth[3]

3 Nowadays, the pachpakal has been transformed in many places into a cultivation space worked with intensive techniques, with continuous use of the soil and some, with organic techniques

***EK CH'OB* SHORT-CYCLE MAIZE SEED AND THE RECADO OR *XAAK.'* PHOTOS: GILBERTO M. GONZÁLEZ KUK**

ASSOCIATED CROPS IN THE MILPA: MAIZE, BEANS, AND SQUASH. PHOTOS: GILBERTO M. GONZÁLEZ KUK

Weeds, Pests and Disease Management

There are many potential threats to crops from planting to consumption. These are divine punishment by the *milperos*. We will review each one.

Weeding depends on rainfall. In case of drought, weeding should not start early because weeds protect the maize from the sun and when there is drought, it is not good to step on the milpa because it damages the maize.

The frequency of weeding will depend on the type of forest (high or low), the fallow time (if it was long or short) and the quality of the burning system. In long fallows, even some 3rd year milpas are weeded once.

Pests do not appear to have been major threats in the history of the Yucatecan Maya milpa until more

recent times. This is because of traditional practices such as field burning and long fallow times that eliminate many of the insects and microorganisms. In addition, scattered distribution of cultivated land does not favor the spread of pests. Temporary land and rotation, crop diversity, weeds, seeding, and good rains provide community resilience.

Several birds and small mammal attack crops. Damage caused by birds pecking maize affects storage, because pecked grains are more susceptible to being attacked by diseases. For this reason, people try to not store them, and they are the first to be eaten. To get rid of the birds, they resort to the use of traps (children hunt them with slingshots), scarecrows, poisoned maize seeds. These birds and mammals, when hunted, are eaten. Hunting, from the logic of milpa agriculture, is a form control predator. These animals cause minor damage in individual milpas, because they distributed in multiple production fields. Therefore, the short-cycle maize that develops early is very vulnerable. As they are not abundant and are available when food is scarce, it is easy for animals to wipe them out. "Early maize" is planted on the plot where it can be cared for by women.

According to Maya cosmovision, animals earned their right to eat seeds, because they helped humanity to rescue them from the fire where the gods had placed them (Terán y Rasmussen, 2008). These beliefs and knowledge allow us to understand that ritual cleansings have been a very important form of predator control for *milperos*. The sacred atole or *sak´ab* is offered in all agricultural ceremonies and at the time of sowing. It is offered to the gods *yum k'aax* and *metan lu'um*, (guardians of birds and land animals), to ask them to take care of their animals so that they do not attack the milpas.

Illnesses are conceived as evils caused by certain types of rain sent as punishment. The *chako'ob* or rain gods, extract water from certain *cenotes* or from the sea and pour it on fields, following superior orders. They are divine punishment. The best preventive practice from these diseases is to sow in time.

Cyclones and hurricanes are a relatively frequent phenomenon in Yucatan. They are dangerous because they can cause *chak lé* and with it comes the threat of total crop loss. When cyclones become hurricanes as their wind speed increases, they become very dangerous, especially if they come inland because they destroy the milpas. Although maize grain is brought from other places for the next cycle, native seeds are lost. For *milperos*, hurricanes traditionally occur because of divine intervention: they can be divine punishment and the work is done by a *chaak* riding a skinny horse, which is called the *tsayan tzimin*, it may also result from a war between good and bad *chaak'ob* (Konrad, 1985).

Another threat that has historically hovered over crops is the sun or drought, called *kin* in Maya. Because of this, there are practices as not weeding early to provide protection and moisture to the crops. Also, the use of resistant maize varieties such as the long-cycle yellow bacal maize. However, the most abundant practices have been multiple *novenas* and ceremonies.

Soil and Water Related Practices and Management (Soil Fertilisation, etc.)

All agricultural work is done on a rainfed basis and no irrigation systems are used. The Yucatecan plateau is deprived of rivers, lagoons, and other types of surface watercourses, so that everything depends on seasonal rainfalls. To cope with these conditions, a system of very detailed traditional knowledge of weather is of great help in defining the right moments to devote to land preparation, sowing, inter-cropping, harvesting, etc. A large underground aquifer provide water for human consumption.

Due to the decrease in forested areas caused by population growth and cattle ranching, the use of chemical fertilizers has increased during the last 50 decades. Tourism and Cancun were promoted, and the *milperos* went to work to buy fertilizers and herbicides, since weeds have become more common because of the reduced fallow times. This practice has become widespread since the 1970s. It has been encouraged by official agricultural institutions through credit loans.

On shared cropland, even 1st year milpas required fertilizer. 3rd year crops are not usually fertilized, because they benefit from the effects of previous fertilizations.

Tools and Types of Labor Force (Animals, Machines, etc.)

Human labor is the most important input used in milpa cultivation. Neither animal traction nor machine force is used. Tools used for cutting trees, bushes, and vines involve the use of wooden sticks, machetes, and/or hoes and axes. Planting is done with wooden sticks to open holes in the ground where seeds are placed. Finally, hoes are used when it is necessary to weed by hand. Harvesting is done by hand, sometimes using a machete.

Sustainable Resource Management Practices

As many different crops are planted in the milpas, harvest time is very long and variable because the species and varieties involved have different ripening cycles, with planting seasons that also have a wide margin of variation. Another element that makes harvesting vary is that it is very different to harvest dry harvests than fresh, as we described with maize.

Harvest times for the different components of the milpa, except roots and tubers, can be grouped: Although the large maize harvest (which matures in August) is undoubtedly the most important of the harvests, it is very interesting to note that the milpa even in May. The *ibes* bloom a second time if there are winter rains and cannot be harvested until May and we have also seen harvests of the *xtoop* seed in May. This harvest is not done until May because the seeds become stained and lose their market value, but from the view of self consumption, it does not matter. In addition, corresponding to the four types of maize in relation to their cycle, we have four maize crops per year.

The possibility of having crops practically all year-round is very important in understanding the old security mechanisms that the milpa strategy put in place to ensure food security. Currently, with the existence of new supply systems, it is not a generalized practice to ensure production all the time, but the existing genetic resources have made it possible, at least potentially.

Human labor

is the most important input used in milpa cultivation

Interestingly, harvest times for some roots and tubers can last up to five years after planting. This is an important aspect of the milpa agricultural strategy because it has provided food security during critical years, constituting an emerging resource. This has been possible because some variants remain stored in the soil for several years, in *hu'che's*, which are lands that have been "abandoned" for two or three years, these specimens can be harvested and mixed with maize to increase the amount of masa dough. In many towns, the cultivation of these specimens has been lost, because this old strategy has been replaced by the possibility of import maize. In addition, the production conditions have been lost along with the fertility of the land.

The milpa with maize plants is associated with bean, squash, lentils, tubers and roots, chilli, tomato, watermelon, melon, cucumber, and other species.

Agroecological Practices (e.g. Beneficial Relations among Crops and Other Agricultural Activities, including Aquatic Animals: Highlight Synergies and Ecological Services Management)

As we have pointed out several times in this

PRODUCTIVE UNITS WITH SUSTAINABLE INNOVATIONS AND PRACTICES. PHOTO: GILBERTO M. GONZÁLEZ KUK

proposal, the milpa has been managed by slash-and-burn technology because it is the only and best way of agroecological management in the area, given its ecological limitations.

Slash-and-burn is necessary to clear land for cultivation. But it is also a process to incorporate nutrients from vegetation into the nutrient-poor soils of the forests. In the region's forests, the nutrient cycle is very fast because heat and moisture cause the vegetation to absorb nutrients rather than the soil accumulating them. We could say that fertility lies within the vegetation of the forests. In the Yucatan Peninsula, land has traditionally been used for cultivation for 2-3 years, and then left to rest for 16-18 years, allowing its fertility to fully recover.

This cultivation method has been the only way to clear land and to incorporate nutrients that are not lost in high temperatures, such as potassium and phosphorus. It also helps eliminate weeds and allows the removal of any pests and diseases (Acosta et. al., 1984). Therefore, traditionally, herbicides and pesticides were not needed.

- Agricultural Practices to Prevent Negative Affects on the Environment, including cultural rituals

When slashing, it is important to consider the position of the bushes and trees. When cutting the trees, ensure that they fall in the milpa's quadrant to facilitate the fire during burning. Stumps are left at a height of between 0.50 and 1 m., This is done for the regeneration of vegetation, a factor which has been pointed out by experts: "the great capacity of the vegetation to renew its development from the root and stumps that persist through the burn and their asexual reproductive pattern, plays a relevant role in the development and establishment of succession, as well as the in conservation of germplasm under the slash-and-burn. Most tree and shrub species that appear after land abandonment come from stumps of timber species that were left after the slash-and-burn of vegetation." This is important for the development of succession because it makes up a significant advantage for the establishment of these species by altering the succession from bare to ground. This is how large trees and bushes are formed in a such short time, which would be different if they had to germinate from a seed. Another advantage that Levy and Hernandez point out is the mainly asexual form of reproduction of tree vegetation, which allows it to triple its density after one year of fallow (Levy and Hernandez, 1989).

Watch your back. If the tree is cut lower, there is

a risk of cutting the foot and also there is a risk of damaging the axe with a stone; at this height, the trunk is also not as thick. Stumps which belong to species that are good for firewood can be used later.

Protection of useful trees

Traditionally, protecting edible plants was essential, especially when we consider that in years of crisis (which were frequent) these plants were an indispensable resource. Other protected trees are those used for construction and for firewood and charcoal. Sometimes large plants are left because cutting them down is a lot of work.

The burning is performed by at least two people and is fast (1/2-1 hour), but it takes half a day to prepare. Before the burning, the *milpero* must go around the field, making noise so that animals run away and are not burned. It is the *milpero's* duty to warn them.

Before the burning, torches or *taj che'* are prepared with woods which crack and burn well. The torches are prepared by making several longitudinal cuts which are then tied together with vines.

With the torches in hand, the two burners' head to a point which is opposite to the south (this can be southwest, northwest and northeast) and walk along the firebreak, towards opposite sides, distributing the fire as much as possible.

If the wind stops blowing, they whistle to call them back. It is not good if the wind stops blowing, if it changes direction, or if it rains. A good burn depends not only on knowledge but also on luck.

A count of the animals burned to ask for forgiveness during the rain ceremony.

After planting, a ceremony is held to ask for rain, (called *Ch'a Chaak*) and while the maize is growing, individual rituals are performed in the milpas to ask that crops be protected against animal attacks. After harvest, they also perform rituals to thank the corn maturation.

IV 3.2. Land Use and Ecosystem Function of the GIAHS Zone

Highlight the beneficial relationship between species and the ecosystem services provided by the agricultural system, including cultivated and associated agrobiodiversity. (This aspect has been described en IV.2)

- List of preserved species connected (wild relatives, plants, animals, microorganisms) to the system (e. g. forest management) highlighting threatened species/varieties and how the system contributes to their maintenance

Plants

The Maya *milperos*, for millennia, have found multiple wild plants in the mountains to cover multiple needs. The largest number of species used by them are medicinal plants, but there are also many ornamentals, others are for construction and tools. All timber can be used as firewood. But some species are more used for their qualities to be burned. Some are for animal fodder, animal food, basket materials, nectar, pollen, tannins for pickling, dyes, medicines, toys, soap, disinfectants and rituals (Anderson, 2001). In this part, we will only go to some of the most used ones.

Melliferous Flora

The Yucatan Peninsula is considered the zone with the highest honey production in Mexico. This is due to three positive conditions: 1) Since pre-Hispanic times, there has been a beekeeping management; 2) The peninsula has a uniform climate, and a relative humidity that doesn't drop below 20% even in the dry season, and 3) The management style that the *milperos* have historically used with regard to the land; when they abandon fields for the fallow, many melliferous specimens (nectariferous and poliniferous) appear and their frequency and density provides a significant amount of nectar and pollen when they bloom. Around 900 species of melliferous plants have been registered (Flores, 2010). In recent years, the important role that bees play as pollinators and the dangers of their decline due to the growing planetary deforestation and the climatic change have been highlighted.

MAIN MELLIFEROUS AND POLLINIFEROUS PLANTS [1]

Spanish common name	Scientific name	Nr	P	Description	IUCN threat category 2022
Ts'its'ilche'	*Gymnopodium floribundum*	x		Bush or tree up to 12 m high	Least concern
Tajonal	*Viguiera dentata*	x		Erect herbaceous plant growing up to 2.5 m	Data deficient
Flor de San Diego	*Antigonon leptopus*	x		Climbing plant, small or long with oval cordate leaves	Data deficient
Algarrobo	*Samanea saman*	x	x	Tree up to 30 m high	Least concern
Almendra	*Terminalia catappa*	x		5 to 16 m tree with wide spreading horizontal branches.	Data deficient
Box katsim	*Acacia gaumeri*	x	x	Shrub or low branching tree growing up to 8 m (26ft)	Near threatened
Chakaj	*Bursera simaruba*	x	x	Tree up to 30 m high with a diameter of 1 m	Least concern
Chechem	*Metopium brownei*	x	x	Tree up to 25 m high with straight trunk and 60 cm diameter	Least concern
Ciricote	*Cordia dodecandra*		x	Tree up to 30 m high with straight trunk and 70 cm diameter	Data deficient

1 Source: Field work, 2000, Raul Zapata en Durán R. y M. Méndez (Eds.). 2010. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA, 496 pp.

Spanish common name	Scientific name	Nr	P	Description	IUCN threat category 2022
Cocoyol	*Acrocomia mexicana*		x	Plant up to 15 m high with a trunk diameter of 40 cm	Data deficient
Ek'balam	*Croton flavens*	x		2 m high aromatic shrub with elongated leaves	Least concern
Flamboyán	*Delonix regia*	x		Highly branched tree up to 12 m in height	Least concern
***Zak nikté*/Flor de mayo**	*Plumeria rubra*	x	x	Tree up to 25 m high with a trunk diameter of 60 cm	Least concern
Huaya	*Talisia olivaeformis*	x		Tree up to 20 m high with a trunk 60 cm in diameter	Data deficient
Ja'abin	*Piscidia piscipula*	x		Tree up to 20 m high with a trunk 50 cm in diameter	Least concern
X'k'anlool	*Senna racemosa*	x	x	Tree up to 6 m high, straight trunk, branched and scattered crown	Least concern
Kitim-che	*Caesalpinia gaumeri*	x	x	Tree up to 20 m tall with straight trunk and irregular crown	Data deficient
Limonaria	*Murraya paniculata*	x		Bush or small tree with small or clustered leaves	Data deficient
Lluvia de oro	*Cassia fistula*	x	x	6 to 8 m tree with feathery leaves.	Data deficient
J'muk	*Dalbergia glabra*	x		Bush, sometimes climber with alternate leaves	Least concern
Nance	*Byrsonima crassifolia*	x	x	Bush or tree up to 10 m high with trunk 10 cm in diameter	Least concern
Paraíso	*Moringa oleifera*	x		Bush 4 m tall, whitish bark	Data deficient
Piich	*Enterolobium cyclocarpum*		x	Tree up to 30 m high with a trunk diameter of 30 cm	Least concern

Spanish common name	Scientific name	Nr	P	Description	IUCN threat category 2022
Pixoy	*Guazuma ulmifolia*	x		Tree up to 25 m high with a trunk diameter of 30 cm.	Least concern
Pukté	*Bucida buceras*	x		Tree up to 35 m high with a trunk of 1.50 m in diameter	Data deficient
Sak katsim	*Mimosa bahamensis*		x	Bush 1 to 4 meters high, leafy, gray bark	Data deficient
Sak-piich	*Acacia glomerosa*	x	x	Spiny tree up to 30 m high, straight trunk	Data deficient
Tamarindo	*Tamarindus indica*	x	x	Tree up to 15 m high, with abundant branches	Data deficient
Ts'u-ts'uk	*Diphysa carthagenensis*	x		12 m high tree, straight trunk, brown bark	Least concern
Tsalam	*Lysiloma latisiliquum*	x		Tree up to 20 m high, straight trunk 80 cm in diameter	Least concern
Ya'axnik	*Vitex gaumeri*	x		Tree up to 30 m high with straight trunk 80 cm in diameter	Least concern
Zapote	*Manilkara zapota*	x	x	Tree that reaches up to 40 m in height with a trunk of 1.50 m in diameter.	Least concern

*Nr=Nectar P= Pollen

Medicinal Flora

In the Maya communities there are specialties to cure diseases, among which are the *yerbateros*, -who dominate the knowledge of plants-, the *sobadoras*, the bonesetters, the midwives and the *J'menes* or Maya priests who attend both agricultural ceremonies and rituals, as well as the healing of "cultural" diseases, which are those caused by the "bad winds" and among which are some associated with the milpa and its products. There are supernatural guardians of the milpas called aluxes that the *milperos* "hire" to take care of them. If someone enters to rob a milpa with a guardian, the alux provokes diseases that only the *j'men* cures. At present, 648 medicinal species have been registered in 405 genera and 116 families. Below is a table with the medicinal species used in the largest number of ailments.

SPECIES OF MEDICINAL PLANTS USED IN MOST OF AILMENTS [1]

Scientific name	Spanish common name	Ailments		IUCN threat category 2022
Ocimum micranthum	*X'kakaltun*, albahaca de monte	• Fever • Healing • Wound disinfectant • Diarrhea • Dysentery	• Grain Sores • Stomach problems • Skin rash • Measles	Least concern
Asclepias curassavica	*Pool kuts*, cancerina, *anal xiw,* anal *k'aax*	• Bile Cancer • Healing • Toothache • Skin diseases	• Lip fire • Pimple • Wounds • Snake bite Warts	Data deficient
Croton chichenensis	Xikin burro, ek'balam, xikin ch'omak	• Healing • Dysentery • Lip fire • Pimple • Hemorrhage	• Minor injuries • Oral herpes • Sores • Rash • Scabies	Data deficient
Senna atomaria	X-tu'ja'abin, tu'ja'ché	• Dysentery fever • Nosebleed • Hemorrhage • Wounds	• Inflammation • Bad air* • Night sweats • Brain disorders	Least concern
Heliotropium angiospermum	Cola de alacrán, rabanico, nej mis, x- tá ulum maax	• Diarrhea • Green diarrhea • Dysentery • Stomach flu • Pimple	• Wounds • Bad breath • Eye spell** • Rash	Data deficient
Rauvolfia tetraphylla	Cabal muk, veneno xiw	• Antihemorrhagic Healing • Pimple • Mushrooms Infection • Kill the animal worm	• Pellagra • Eyes bumps *(muk´)* • Warts	Data deficient

1 Source: Durán R. y M. Méndez (Eds.). 2010. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA, 496 pp.

Scientific name	Spanish common name	Ailments		IUCN threat category 2022
Jatropha gaumeri	*Pomol ché*	Healing Blood coagulant Dysentery Stomach ache	Foils Fire in the mouth Hemorrhage	Data deficient
Psidium guajava	*Pichi'*, guayaba	Diarrhea Dysentery Stimulates breast milk Lip fire	Grain Rash Smallpox	Least concern
Hamelia patens	*X-k'anan*, coloradillo	Healing Pimple Rash	Scabies Smallpox	Least concern

* It is a disease condition associated with the Maya cosmovision (cultural diseases), when at certain times of the day, negative energies circulate through air currents, which can damage a person's health.

** This is part of the Maya cosmovision, through the customs and ways of generating ailments through the gaze of one person to another, related to spiritual energy. Commonly associated with infants and children.

Forage Species

As for the forage species used in the various Maya communities of the Yucatan Peninsula, there is a record of 192 species (Durán, et al. 2010), of which the leaves, roots, fruits and seeds are mainly used to feed cattle ranching, such as: chickens, turkeys, ducks, pigs, cows, horses, goats and occasionally deer. (See tables).

LIFE FORM AND NUMBER OF FORAGE PLANT SPECIES [1]

Life form	Number to forage plants	%
Trees	33	17
Shrubbery	19	10
Herbs	138	72
Palms	2	1
Total	192	100

1 Source: Durán R. y M. Méndez (Eds.). 2010. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA, 496 pp.

Family	Forage plants
Amaranthaceae	4
Araceae	1
Bromeliaceae	1
Burseraceae	1
Caricaceae	2
Compositae	6
Convolvulaceae	23
Cucurbitacea	4
Dioscoreaceae	1
Gramineae (Poaceas)	29
Iridaceae	1
Labiatae	2
Leguminosae	70
Malphigeaceae	6
Malvaceae	6
Moraceae	4
Musaceae	3
Nictagynaceae	6

Family	Forage plants
Oleaceae	1
Orchidaceae	2
Oxalidaceae	2
Palmae	2
Passifloraceae	1
Piperaceae	1
Polygonaceae	1
Portulacaceae	3
Rhamnaceae	3
Rubiaceae	3
Simaroubaceae	1
Solanaceae	7
Sterculiaceae	2
Tiliaceae	1
Ulmaceae	1
Verbenaceae	5
Zygophyllaceae	1
Total	192

Forest Species

For the Yucatan Peninsula, there is an estimate of 619 forest species, according to the naturalist platform, under the project called “Forest Species of the Yucatan Peninsula”, where observations are stored since 2020 from the states of Yucatan, Campeche and Quintana Roo.

According to this platform, there are several species that are used by Maya communities through the milpa system. Among them, 18 species are mentioned that play, in particular, a key role in the daily life of the communities. Their use is varied, including construction, use like fuel source and ornaments.

Likewise, although these species are not currently under a considerable threat category by the IUCN, their risk is imminent due to the accelerated advance of phenomena as urbanization and cattle ranching that deforest extensive areas of land, as well as forest fires and illegal logging.

FOREST SPECIES USED AS FIREWOOD, CHARCOAL AND CONSTRUCTION MATERIALS IN YUCATAN [1]

Maya common name	Scientific name	IUCN threat category 2022
Katsim	*Acacia gaumeri*	Near threatened
Ja'abin	*Piscidia piscipula*	Least concern
Chukum	*Pithecellobium albicans*	Data deficient
Mora	*Chlorophora tinctoria*	Least concern
Ts'its'ilche'	*Gymnopodium floribundum*	Least concern
Tsalam	*Lysiloma latisiliquum*	Least concern
Boob	*Coccoloba spicata*	Least concern
Sabakché	*Exostema caribaeum*	Least concern
Cholul	*Apoplanesia paniculata*	Least concern
Sak cocom	*Laguncularia racemosa*	Least concern
K'oxol-aak	*Spartina spartinae*	Data deficient
Botoncillo	*Conocarpus erectus*	Least concern
Waxiim	*Leucaena leucocephala*	Data deficient
Huaya	*Talisia olivaeformis*	Data deficient
Taman	*Gossypium schottii*	Data deficient
Chakaj	*Bursera simaruba*	Least concern
K'anasín	*Lonchocarpus rugosus*	Least concern
Xu'ul	*Lonchocarpus xuul*	Data deficient

Mammals Hunted in the Maya Milpa Zone

The animals most frequently used as food are: Mammals (12 species) including: white-taile deer, collared peccaries, rabbits, badgers and agoutis birds (17 species) of which the most consumed are: chachalacas, quaol and four species of pigneos.

The deer has been the favorite hunting prey of the Maya for millennia, as well as being a figure related to magical beliefs and a character in many tales. This animal likes the murky land where there is scrub vegetation, hubche because it hides them better, and they can find more food than in high mountains, where there is practically no grass. Grasses are abundant in *hubcho'ob* and in the surrounding milpas. Many wild animals, including deer, like to feed on twigs, fruit, bark, and leaves of secondary vegetation. In addition, it is common to find deer in the plowed milpas, when there are traces of new vegetation, before the burning of the milpas. In other words, deer prefer recently abandoned areas or those in the early stages of growth. Another important hunting site, individually, is the milpa belonging to the *milpero* and its surrounding areas.

1 Source: Durán R. y M. Méndez (Eds.). 2010. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA, 496 pp.

Traditionally, there has been and still is an important symbiotic relationship between milpa and the deer. Santos F. Didac (2013) proposes that in the milpas, traps will attract deer. But the deer is not the only animal that is hunted by the *milperos*. Here is a list of edible wild animals.

WILDLIFE USED FOR FOOD: REPTILES, BIRDS AND MAMMALS [1]

Scientific name	Common name
Reptiles	
Rhinoclemmys arealata	Wood turtle
Terrapene caralina	Box turtle
Trachemys scripta	Pond slider
Ctenosaura similis	Black iguana
Crotalus durissus	Rattle snake
Birds	
Crypturellus cinnamomeus	Partridge
Dendrocygna autumnalis	Black bellied whistling duck
Ortalis vetula	Chachalaca
Crax rubra	Curassow
Meleagris ocellata	Ocellated turkey
Colinus nigrogularis	Quail
Dactylortyx thoracicus	Quail
Patogioenas flavirostris	Red billed pidgeon
zenaida asiatica	White-winged dove
Columbina talpacoti	Ruddy ground dove
Leptotila verreauxi	White-tipped dove
Amazona albifrons	Parrot
Amazona xantholora	Parrot

Scientific name	Common name
Crotophaga sulcirostris	Groove-billed ani
Malanerpes aurifrons	Golden-fronted woodpecker
Cyanocorax yucatanicus	Yucatan Jay
Quiscalus mexicanus	Mexican grackle
Mammals	
Dasypus novemcinctus	Armadillo
Urocyon cinereoargenteus	Gray fox
Nasua narica	White-nosed coati
Procyon lotor	Raccoon
Pecari tajucu	Collared peccary
Mazama americana	Deer
Odocoileus virginanus	White-tailed deer
Sciurus yucatanensis	Yucatecan squirrel
Orthogeomys hispidus	Gopher
Dasyprocta punctata	Agouti
Agouti paca	Paca
Sylvilagus floridanus	Rabbit

1 This table was formed based on three paintings by Chablé S., Juan and H. D. González, (1910: 377, 378, 379), selecting from them only the fauna marked as food.

IV 3.3. Land and Water Management

- Describe traditional knowledge related to land management (e.g. terraces, stone walls, etc.)
- Water management practices and specific characteristics including ponds, dams, integrated aquaculture-agriculture- cattle ranching -irrigation, etc.
- Integration and synergies with the surrounding environment (fintegrated system characteristics, symbiosis with natural environment).

The fallow of 16-18 years is used not only to enhance the recovery of the forest but has traditionally allowed for many agroforestry activities, some of which also provide food, such as beekeeping and hunting. In colonial times, cattle ranching was also developed in the forests. This continued until the last century, as that made it mandatory to keep cattle in an enclosed area in 1972 (Rosales, M., S/f) was approved. Other activities provide the raw materials for the manufacture of instruments, furniture, utensils, and houses, or for medicine, foraging, tanning and as firewood. Kilns are also made for lye and charcoal production, and for extract non-renewable resources such as stone and *sahkab* (white soil and limestone, mixed with lye and used in masonry).

From a spiritual perspective, the forest or *monte* has been the basis of the Maya respect for nature since time immemorial and the foundation of their philosophy, cosmovision, religion, and natural resources management.

Since there is no surface water, irrigation is expected from the rain sent by the watering gods. The relationship with water has always been governed by the religious cosmovision and that is why the Ch'aa Chaak ceremony to request rain has been very important. As for the water that accumulates in sartenejas, which are stone hollows that are containers that hold water during the rainy season, they are very appreciated because they give water to the animals and the milperos use them to water the vegetables of the milpa and to prepare their pozole, which is a ball of corn dough that they take to the plot when they go to sow and they take it as lunch, emptying it in water that they extract from the sartenejas.

IV 3.4. Contribution of Local and Traditional Knowledge to the Sustainability and Resilience

"In Mesoamerican and Maya landscapes, maize is the primary crop and the traditional agricultural field is called the milpa. Milpas are complex polycultural plots in which maize visually predominates, but flourish with many other crops (Teran 1994) including a bewildering variety of weeds that serve as greens, herbs, medicine, pesticides, and herbicides, as well as allelopathic plants (Gliessman 1983). They are cultivated at a distance from settlements or within settlement boundaries, as edible home gardens. When the landscape requires it, they may include terracing or drainage systems, but most are unmodified plots micromanaged for their individual values in ways invisible to archaeologists. The high-diversity, high-yield milpa (Wilken 1987) is closely allied with the surrounding forests, mimicking species composition and structure. The milpa forms an intrinsic part of the complex relationship between the agricultural communities and forest landscapes that together create the Maya Forest." (Nigh and Ford, 2019)

"Maya's significant impact on the landscape is emphasized by their resilience, growth, and success over the millennia. Their agricultural systems, adapted to seasonal deluges and droughts (cf. Whitmore and Turner 2002), survived both precipitation excess and deficits at several critical times."

"Certainly, the relationship between people and the environment was at the core of changes associated with the end of the Classic period, yet the ecology of the Maya Forest persisted, only to be threatened today with the pervasive expansion of

MILPERO. PHOTO:MARIGEL CAMPOS CAPETILLO

pasture and plowing. Even with the reorganization of the political and economic systems of the southern lowlands after AD 1000, the milpa system remained the essential subsistence tool in this area into the present (Farriss 1992; Faust 2001)."

"The intensification of land use in the Maya system involved investment in knowledge, skills, and labor. Archaeological evidence found through the mapping of domestic structures shows how these factors materialized in the ancient landscape, as does the ethnographic record of the milpa system. Agriculture was based on the quality and suitability of the land for a wide variety of natural and agricultural products. With the *milperos*, these were family enterprises that provided for the families and also produced enough for the taxes and tribute required by the elites. As these requirements changed, so did land use: more people meant more investment in land and labor; fewer people meant less investment." (Ford & Emery 2008)

IV 3.5. Treats and Challenges

We have no record the loss of knowledge, but we know this is happening. We have already noted that the migration of young people who go in search of work in the Riviera Maya, to other Mexican cities, and the United States, is causing the abandonment of milpa activities and the knowledge on which these activities are based. We believe this phenomenon makes up the most dangerous threat to the milpa, because if young people do not carry out milpa activities and transform them into a viable option for the future, an enormous amount of agriculture, forestry, and ecological experience will be lost. This threat is the most terrible because it comes directly from within the peninsular Maya culture.

4. Cultures, Value Systems and Social Organizations

Describe how the cultural identity and sense of place are embedded in and belong to the proposed site. In addition, illustrate how social organizations, value systems and cultural practices associated with resources management and food production may ensure conservation and promote equity in the use of and access to natural resources. Show how local social organizations can play a key role in balancing environmental and socioeconomic goals, enhancing resilience and reproducing all elements and processes critical to the functioning of the agricultural system.

IV 4.1. Cultural Identity and Agriculture

The peninsular Maya shares a common language and culture which has given them a strong identity over millennia.

Their language is Yucatec Maya and belongs to the Maya language family, which comprises 31 languages. The Yucatec Maya language is the one with the widest continuous distribution, since it is spoken in Yucatan, Quintana Roo and Campeche, the three states of the Mexican Republic that make up the Yucatan Peninsula. Of the 68 indigenous languages that exist in Mexico, it is the second most important. Nahuatl has more speakers, but they are distributed in different states.

The language's importance relating to our topic is that the peninsular *milperos* are all Maya speakers.

Maya speakers in the Yucatan Peninsula in 1990 (see Threats and Challenges of this chapter) we compare this table with 2010 to illustrate cultural loss.

COMPARATIVE TABLE BETWEEN MAYAN SPEAKERS AND THE POPULATION [1]

POPULATION OF THE GIAHS CORE ZONE			
State	**Total population**	**Indigenous population**	**% Indigenous**
Campeche	100,853	40,559	40%
Quintana Roo	129,468	69,480	54%
Yucatan	919,673	388,032	42%
Total	1,149,994	498,071	43%

1 Inegi. 2010. Taken from the CIR-USC-UADY website

Culinary Culture

Specific cultural practices and identity elements related to agriculture: myths and stories, music, dances, languages, historical elements, arts and handicrafts, traditional clothes, architecture, etc.

The central aspect of the culture shared by all peninsular Maya has been the milpa as a productive (with all the activities that have been described in section one) and cultural system.

Directly linked to the food system is the culinary culture that has resulted from it.

In 2014, Salazar reported the existence of 73 dishes in a rural community of Yucatan, of these, 68 dishes included corn in some form. Many dishes are consumed throughout all three peninsular states such as bean broth, chaya with egg, pibinal (baked corn), panuchos, baked deer, baked squash, tamales, ground pepita seed with tomato, cilantro, and chives; the toksel (a tiny seed), *ibes*, scallion, and cilantro, *relleno negro*, baked suckling pig, to name a few.

But it must be said that the tortilla -*waaj* in Maya-, has been the principal food for over 500 hundred years among the Maya *milperos*. It is made with m*asa nixtamalizada* (corn dough which has been treated with lye). Balls of dough are formed and flattened by women on a wooden bench until they are thin and round. Then, they are cooked on a hot pan, called a comal, which is placed on three stones that make up the stove or *kooben*, so that they can cook. They are removed from the comal as they are finished cooking, wrapped in a napkin so that they keep warm. and are put into a *lec* (a container made from a hollowed squash).

Another important food of the milpa is the *pozole* or *k'eyem*, which is the typical *milpero* lunch. It is a ball of corn, that is usually taken to the field to eat while working in the milpa. It is dissolved in water and combined with pepper and salt, but it can also be eaten with honey or sugar. It is also consumed fermented and is known as *pozole agrio*. This pozole

RELLENO NEGRO (LITERALLY MEANING BLACK STUFFING) OR BOX JANAL IS ONE OF THE OLDEST TRADITIONAL DISHES, IT IS MADE WITH TURKEY OR PORK AND BURNT CHILIES AND SPICES. IT IS USED FOR PARTIES AND CEREMONIES. PHOTO: JORGE SÁNCHEZ

IBES WITH PORK (IBES ARE LEGUMINOUS PLANTS VERY SIMILAR TO BEANS THAT CAN BE FOUND IN THE TRADITIONAL MILPAS. PHOTO: MARIGEL CAMPOS CAPETILLO

HARVESTING FLAVORS, RECIPES AND FLAVORS OF THE SELVA MAYA. PHOTO:THE NATURE CONSERVANCY

has lactic bacteria that colonizes the intestine and competes with other 'bad' bacteria (Vassallo R., M., 2008). Nowadays, unfortunately, pozole is being displaced, little by little, by coca cola.

The third most widespread food has been the traditional *milpero* breakfast in the Yucatan Peninsula for generations: it comprises atole or *sa'* or chocolate. *Atole* is made with water and cooked corn dough. This drinking food seems to be older than the tortilla and one of the first foods made from maize (Zisumbo-Villarreal et. al, 2012).

The Maya house

The traditional Maya house has existed for almost 3,000 years, according to archaeological findings in Cuello, Belize, dating back to 900 BC, and is one trait that define the culture of the area together with corn (Gerhardt, J. and Norman Hammond, 1991).

This house is distinguished by its oval-shaped base, a roof of thatched palm or grass, adobe walls, and an approximate size of 8 X 4 m. In Cobá, during the 1970s, the participation of 45 different plant species in the construction of this traditional dwelling was reported, considering the qualities of these species, in combination with the needs of the inhabitants (Villers et al, 1981, 2014) .[1]

The Maya house and its plot have a kitchen, a barn, pigsties, chicken coops, a place to bathe and a well. Not all plots have these elements, except the house and the kitchen. The open space called plot, patio, solar, *tankab* and *kuch* in Maya, has traditionally been used, as mentioned in section one, to grow plants (vegetables, condiments, ornamental, and medicinal) and raise animals (turkeys, chickens, ducks, pigs) with corn, tubers and squashes that come from the milpa plluriculture. At the back of the

TRADITIONAL MAYA HOUSE. TEMOZÓN, YUCATÂN. PHOTO: GILBERTO M. GONZÁLEZ KUK

1 This house was the cradle of monumental Maya architecture. The "Maya arch" or "false arch" is essentially the same as the roof of the Maya house but made of stone. Some parts of the house, such as the adobe walls tied with vines, were architectural elements of large buildings in cities like Labná. Likewise, the Maya house itself made up a decorative aspect of architecture, as reflected on the monumental arch at the aforementioned site (Garcia et. Al., 2014).

plot, fruit trees and other trees are grown.

Traditional Clothing

The dress worn by the *mestiza* (the name given to the Maya women of the Yucatan Peninsula), is called *hipil*. The *hipil* is a square dress, with colorful machine or hand-stitched embroidery around the neck and hem. Underneath the dress is a skirt or slip called *fustan*, which has embroidery that matches the hipil; a shawl is worn as an accessory. This dress has been worn since pre-Hispanic times. The *hipil* is worn by women who live in the city and in the countryside because it is very lightweight and is an important part of regional identity.[2]

Hand-stitched or machine embroidery decorates the *hipil* and the *terno*, which is the fancy version of the *hipil*. It is a symbol of identity because the southeast is the only place in the country where the regional costume is recognized by all social classes. Wealthy women wear the *terno* for some festivals, major events and carnival celebrations.

A MESTIZA OF CAMPAMENTO HIDALGO, YUCATÁN, WEARING A TRADITIONAL HIPIL. PHOTO: GILBERTO M. GONZÁLEZ KUK

The Patron Saints and Union Festivities

The only expression of an organized community life is through the Patron Saint and Union Festivities, both are held as religious festivities (Ramirez, 2006). They always begin with the *jarana* dance which is performed with the terno, which is the fancy version of the traditional regional costume.

These parties involve gremios, or unions, that were originally formed by groups of merchants, which include *milperos*. Now, these gremios are not associated with specific trades. Unmarried girls who dance on their ternos are called *vaqueras*, or "cowgirls" and the festival is called *vaquería*, or "cowshed", because it was born in the colonial era with the introduction of cattle ranching. In the old days, the dance was done as a promise to a patron saint.

All the offerings used in this ceremony are offerings of *tortillas*, *atole* and *cacao*, prevenient from the milpa polyculture.

These festivities are present in all towns and neighborhoods of cities and are an important part of the Yucatecan Maya culture and identity.

The Cult of the Dead is a celebration shared throughout the Mesoamerican region and has pre-Hispanic roots that were merged with Spanish customs. But it has significant differences with other celebrations.

In the Yucatan Peninsula the name of the ceremony offered to dead is called "The Food of the Dead" or *Janal Pixa'an* and it lasts throughout the month of November. On October 31, the souls of children come to eat; on November 1st the souls of the adults come to eat and on November 2 the cemeteries are visited. After 8 days, the souls are bid farewell, but they continue to hover around until November 30.

2 Until the early 19th century, it was made with cotton from the milpa and with geometric designs alluding to the rattlesnake. After Independence, it began to be made with purchased fabric and the flowers use Creoles and mestizos began to be used little by little by the milperas. The making of these clothes was always done within the framework of the milpa economy.

YOUNG MESTIZAS WEARING A TERNO, THE FANCY VERSION OF THE REGIONAL COSTUME. IT IS WORN BY ALL SOCIAL CLASSES IN THE YUCATAN PENINSULA. PHOTO: HTTPS://ES.123RF.COM, RETRIEVED, AUG 2022

A GROUP OF "COWGIRLS" DANCING JARANA IN XOCEN, YUCATÁN. PHOTO: HTTPS://YUCATANTODAY.COM/ RETRIEVED, AUG 2022

GREMIO OR UNION OF LADIES IN XOCEN, YUCATAN. PHOTO: HTTPS://YUCATANTODAY.COM/ RETRIEVED, AUG 2022

The principal food of the dead comprises *tamales* made of corn, *atole* made of corn, and chocolate. There are other meals that are given to the dead, always accompanied by *tortillas*. So, the existence of milpa system is correlated to this practice.

Milpa Family Area

Milpa family area refers to a restricted section in the common land or *ejido*, which is where a *milpero* family usually works. The existence of such an area is due to several reasons. First, the location of the second and third year milpas influences the place where the new milpas will be established, for practical reasons. If the *milpero* has apiaries, these are placed near the milpas to facilitate their care, because when the milpas are visited, the apiaries can be attended, and vice versa. Finally, given that in the milpa family help is often needed when the farmer is sick or has to go to work, it is important that the milpas and apiaries are close to

PHOTO: GILBERTO M. GONZÁLEZ KUK

PREPARATION OF TAMALES FOR THE FOOD OF THE DEAD. PHOTO: HTTPS://WWW.MEXICODESCONOCIDO.COM.MX/ RETRIEVED, AUG 2022

ALTAR WITH OFFERINGS FOR CHILDREN. PHOTO: HTTPS://WWW.MEXICODESCONOCIDO.COM.MX/ RETRIEVED, AUG 2022

the rest of the family unit, so that they can help in case of need.

The milpa family area is a work system that has been in place since pre-Hispanic times (Ortiz, 2014) and confirms the idea that the nuclear and extended family unit are important among the Maya.

Value systems, ethics and nature

We have already mentioned that ethics toward the land are based on the premise that nature is sacred and conscious (See III.A.3.7). This premise sets a limit to man's use of natural resources. Because nature does not belong to man, there is a careful, measured and respectful treatment of it.

Because family is the economic enterprise on which the milpa system is based, unity, responsibility, and solidarity are promoted among its members. Family comes first, as it is the social unity that protects people in times of sickness, disability, unemployment, and old age. First comes the nuclear family, then the extended

family and third the community because through it one can access the legal means to have a house, land for farming, and other resources.

Traditionally, leadership has been male because men work in the milpa and the economy revolves around it. Therefore, in the family, men have occupied the highest rank in terms of decision-making, then come women and then the children. Men's predominance as an economic provider has changed in recent years. As women and young people have to work to bring money into the milpa family, either through community projects or labor migration, this male leadership is being removed by female or youth leaderships. This is the case of Leydy Araceli Pech Marín, from the community of Ich Ek, Hopelchen, Campeche. She is a Mexican beekeeper and activist of Maya origin. In 2020, she was awarded the Goldman Environmental Prize for her work against the planting of transgenic soybeans in the Yucatan Comb carried out with her group Muuch Kambal. Her leadership is related to nature management. In this case, management of bees and more specific to *Melipona* bee, known regionally as "Maya bee" or *xuunan kab* in Maya language.

- Beliefs, Rituals and Symbols linked to Agricultural Production

Jetz Mek

Life cycle and Milpa: A ritual which is specifically linked to the milpa, is the "Maya baptism" or *jetz mek*. It is the first time the baby's legs are opened so that it can be carried on the hip. For girls, it is performed at three months old because this number represents the three stones of the kooben fire where the tortillas are made. This is said to make them excellent cooks. For boys, it is performed at four months old, because this represents the four corners of the milpa and it makes them good *milperos*. Girls are made to touch a needle or a sewing machine to make them good embroiderers, and boys are made to touch a machete, hoe, or sowing stick. More recently,

JEETZ MEK GODFATHER CARRIES THE CHILD WHILE THE GODMOTHER BRINGS A MACHETE FOR THE BABY TO LEARN HOW TO KNOCK DOWN TREES AND MAKE MILPA. PHOTO: HTTPS://WWW.MILENIO.COM/ RETRIEVED, AUG 2022

both boys and girls are given books, notebooks, laptops, and cell phones, but they are also given the tools associated with traditional roles. The ceremony is also about opening the minds of children so that their understanding is opened and they can learn better.

Rituals or Ceremonies that the Maya Have Carried Out in Use and Management of Forest and Land Resources

Request for Permission to Clear High Vegetation, jo sa sakab

A ceremony is performed for *yuum k'aax* or *kanaan k"aax*, the owner of the forest, is done to let him know they will work there, to ask for permission, and to ask him to remove his animals, especially those who bite, such as snakes. They also ask for protection from work-related accidents such as branches falling on them or being cut. The request is made through an intermediary *j'men* or Maya priest. In forests with low vegetation, it is unnecessary to perform this ceremony.

SANTA CRUZ. PATRON SAINT OF THE MAYA VILLAGE OF XOCEN, VALLADOLID, YUCATAN. CORN OFFERINGS FOR THANKSGIVING OR HOL BESA NAL. PHOTO: HTTPS://WWW.RANCHOCAMPESTREPALCHAHAL.COM/ RETRIEVED, AUG 2022

***CH'A CHÁAK*. RAIN PETITION CEREMONY IN XOCEN, VALLADOLID, YUCATÁN. MAIN ALTAR WHERE OFFERINGS TO THE GODS ARE PLACED. THE ARCHES ARE THE HEAVENLY SKY. PHOTO: HTTPS://WWW. MEXICODESCONOCIDO.COM.MX/ RETRIEVED, AUG 2022**

COMMUNITY PRACTICE GIVEN THE ERRATIC RAINFALL OF THE AREA. PHOTO: BERNARDO CAAMAL ITZÁ

Asking for Help for a Good Burn. Ts'a siskunaj ol ti ik yum yum yetel you k'a'ak '

Eleven *jicaras* or *sejul luch* are set (these are small bowls made of a hollowed gourd) are placed on a table of sticks with sacred *pozole* or *sakab*, two others are placed on the floor. Different caregivers are called out to: the caregivers of the wind or yum *ik'ob*, the caregivers of the fire or *yum k'a'ak'ob*, and the caregivers of the land or yum kalan lu'um. After the ceremony, the burning begins and when the job is done; the *sakab* is passed around. The ceremony can be led by a *j'men*, who is a Maya priest, or by the *milpero* himself. In the days after the burn, the animals that died in the fire are counted and when the *ch'a chaak* is performed, which is the ceremony asking for rain (see next paragraph), the owner of the forest metan lu'um or *kanaan* lu'um is asked for forgiveness. He also comes to the *ch'a chaak* as a guest, and is the owner of the animals, for which forgiveness must be asked.

Asking for Rain, Ch'a chaak

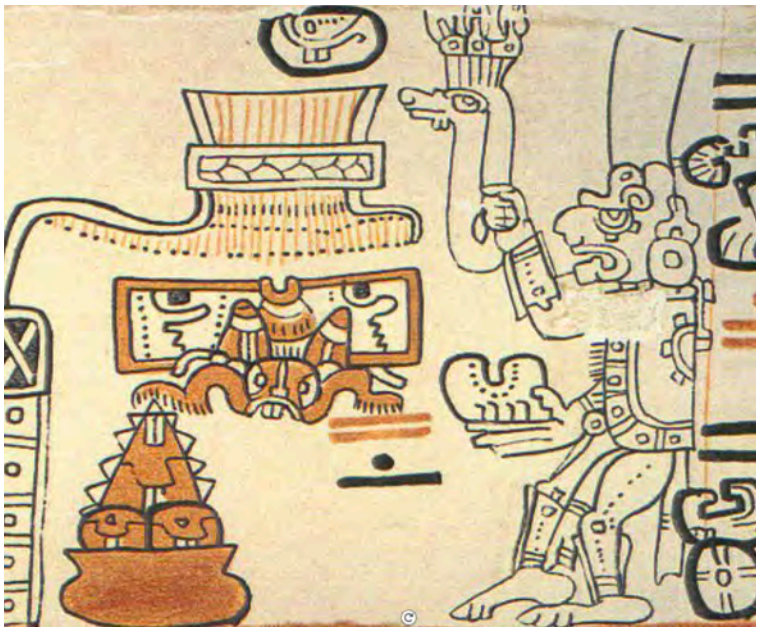
The *ch'a chaak* is a sacred event during which all the major gods, including Christian saints and Maya supernatural beings, are invited to eat. The ceremony takes place to let these deities know the sowing has been completed, and to ask them to do their divine work so that the crops go well. They ask the rain gods to water and other supernatural beings to collaborate so that they have a good harvest. To the caretakers of the land, they ask them not to allow a branch to hurt them, to the caretakers of the cenotes they ask for permission to take water from the *cenotes* for irrigation, to the owner of the animals of the land they ask him not to allow his snake to bite the *milperos*, etc.

Traditionally, it has been an indispensable community practice given the erratic rainfall in

A CH'A'ACHÂAK CEREMONY. XOCEN, VALLADOLID, YUCATAN. PHOTO: HTTPS://WWW.YUCATAN.COM.MX/ RETRIEVED, AUG 2022

the area. In a region with irrigation, the next step would be watering, but where irrigation is not in the hands of men, but of the gods, it is logical that *milperos* do not just wait and see what happens. After the sow, comes the time to pray for rain. [1]

From September or October, when the large corn, or *xnuk nal*, matures, each *milpero* and their relatives perform this thanksgiving ceremony or *Hol besa nal* before they consumng the corn. It is not done by those who lost their harvests or by those who have to go to work and have little time to make their offering; however, even they perform a small thanksgiving at home. The prayer can be led by a *j'men* or by the *milpero* himself.



REPRESENTATION OF THE MELIPONA BEECHEII OR XUNAAN KAB IN THE MADRID CODEX. THE BEE IS IN ITS JOBON AND A DEITY IS MAKING AN OFFERING. PHOTO: HTTPS://WWW.REVISTA.UNAM.MX/ RETRIEVED, AUG 2022

Other Ceremonies

Milperos celebrate small rituals in the forests surrounding the milpa when excessive animal attacks occur. The owner of the land animals or birds, is requested to tie up his animals to avoid having to kill them.

Requesting Permission to Hunt, Giving Thanks to the Animal Owner and Deer Owner for a Certain Number of Hunted Species, and Keeping the Deer's virtue, Loj tson or k'eex

First, the *milpero* must ask for permission to hunt from *laj kaj* or *sepo* (the caretaker of a certain part of the forest who sometimes manifests himself as a stone) and / or tsip, the owner of the deer. He must offer sakab or burn xix incense before hunting.

Asking for Permission to Collect Honey from the *Melipona* Bees Belonging to *yum kab*, *loj kab*

The *xunaan kab* is the traditional bee of the region and is closely linked to the Maya *milpero* culture and their destiny. Just like the *milperos*, *kolel kab* is gentle and produces enough for itself and for others. Also, like the *milperos*, the native bee lives on the plot, but can survive in the forest. The *xunaan kab* bee originally lives in old, hollow tree trunks in the forest, as wild bees. *Milperos* have to ask for the bees' protection once a year, or once every two years at most. The *loj kab* ceremony addresses the balam of the land where the *jobones* are, to protect the bees against birds and diseases. During the ceremony, food is offered to the *balam*, and he is asked to withdraw his harmful animals. The *loj kab* ceremony is led by a *j'men*.

1 Source: http://www.revista.unam.mx/
Source: https://www.veinteveinteyucatan.com

IV 4.2. Social Organization and System's Management

- List organizations, such as Community-based Organizations (CBO's), farmer's cooperatives, women associations, youth cooperatives and associations, NGOs, Foundations, etc. related to agricultural tasks or strengthening the role of *milperos* within the proposed system (example of gender organization, tasks re-partition, mutual aid, etc.) highlighting their role in the maintenance, evolution and transmission of the proposed system.

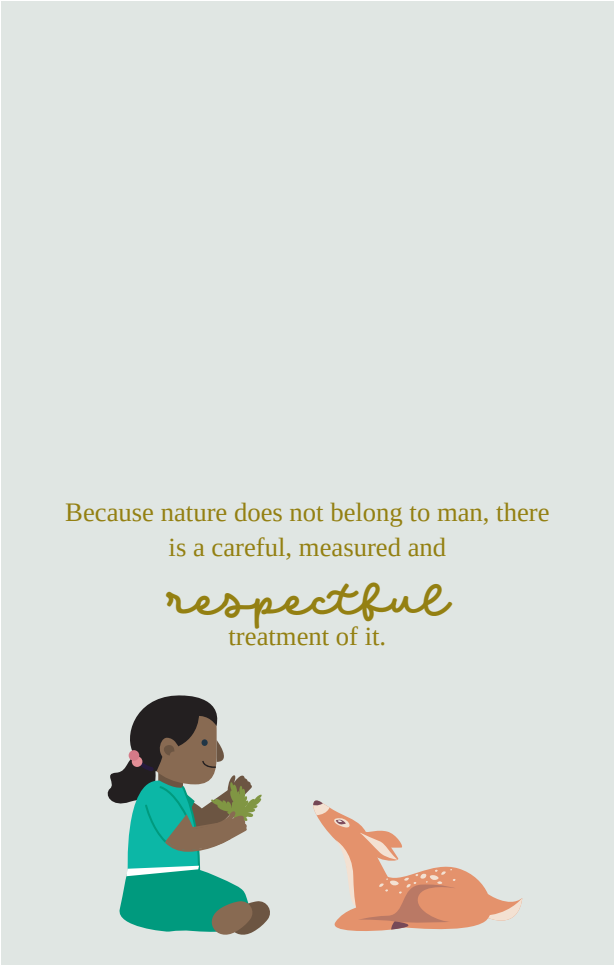
In the Yucatan Peninsula, there are official political organizations called municipalities. Only in the east of the peninsula there is the *guardia*, or guard, this is a system that worked during colonial times, it is maintained in communities that were the most combative during the "Caste War," in the forests of Quintana Roo and in eastern Yucatan. It has been maintained in these places, perhaps because it was based originally on a military structure.

The states are divided into municipalities, of which there are 106 in Yucatan, 10 in Quintana Roo, and 11 in Campeche. In Campeche and Yucatan towns make up *ayuntamientos* or city halls, and are organized into *comisarias*, or commissariats. There is a Municipal Commissariat that serves civil affairs and a Common Land Commissariat that deals with agricultural matter. In Quintana Roo, there are no commissariats, but delegations and sub-delegations.

These administrative organizations are recognized by the Maya population and are governed by them.

Municipal Commissariat comprises a president, a secretary, and a treasurer. The president is the one who organizes the town's activities related to health, education, and festivities. He serves as a bridge between external authorities and the community.

Common Land Commissariat (*Comisario Ejidal*) is in charge of all matters related to the *ejido*. This position usually lasts for three years. The Assembly is the highest authority. There is a president or secretary, a treasurer and a supervisory board. The president takes care of the common land and ensures that large trees are not cut down. These are only cut to make furniture for common use. He also ensures that common land is not stolen. He coordinates with external authorities regarding government programs for the *ejido*. He oversees firebreaks are properly constructed so that fire does not spread throughout the common land. The secretary is a substitute for the president when he leaves town to run errands and supports him with different tasks assigned to him. The supervisory board monitors problems and ensures that they are resolved properly. For example, they monitor for forest fire activity that might spread to the common land, and also ensure that no large plants are stolen.



CEREMONY AT THE XOCEN COMMISSARIAT TO ASK THE AUTHORITIES TO FULFILL THEIR JOB WELL WITH THE PEOPLE. PHOTO: CHRISTIAN RASMUSSEN.

Community groups related to milpa system activities

State	Name group	Organization type	Legal situation	Land use
Yucatán	Turismo Comunitario Muchucuxcah	Cooperativa	Ejido	Milpa y apicultura
Yucatán	Kuxtalil S.C.	Cooperativa	Indefinido	Milpa y apicultura
Yucatán	El Campo es Vida	Familiar	Indefinido	Milpa y apicultura
Yucatán	Xjon-ha'ac de Sudzal	Familiar	Indefinido	Milpa y apicultura
Yucatán	EDUCE SC	Cooperativa	Indefinido	Milpa y apicultura
Yucatán	Yaax Tekit	Familiar	Indefinido	Milpa y apicultura
Yucatán	Ki Ich Inkal	Familiar	Indefinido	Milpa y apicultura
Yucatán	Muuch Xiimbal	Colectivo	Indefinido	Milpa y apicultura
Yucatán	U Najil Ek-Balam	Cooperativa	Ejido	Milpa y servicios turísticos
Yucatán	Campamento Hidalgo	Cooperativa	Ejido	Milpa y servicios turísticos
Yucatán	Cenote Choojá	Ejido	Ejido	Milpa y servicios turísticos
Yucatán	Punta Laguna	Cooperativa	Indefinido	Milpa y servicios turísticos
Yucatán	Centro Cultural Comunitario de Yaxunah	Centro comunitario	Ejido	Milpa y servicios turísticos
Yucatán	Cenote Yokdzonot	Cooperativa	Ejido	Milpa y servicios turísticos
Yucatán	Misioneros A.C.	Centro comunitario	Ejido	Milpa y apicultura
Yucatán	Turismo Indígena San Agustín	Ejido	Ejido	Milpa y servicios turísticos

State	Name group	Organization type	Legal situation	Land use
Quintana Roo	U yoochel Maya	Cooperativa	Indefinido	Milpa y apicultura
Quintana Roo	La Flor de Tajonal	Cooperativa	Ejido	Milpa y apicultura
Quintana Roo	Ejido Caoba	Cooperativa	Indefinido	Milpa y apicultura
Quintana Roo	Kiichpam Kaax	Cooperativa	Ejido	Milpa y servicios turísticos
Quintana Roo	A´aktun Jaleeb	Sociedad de producción rural	Ejido	Milpa y servicios turísticos
Quintana Roo	Mujeres, Organización y Territorios MOOTS	Cooperativa	Indefinido	Milpa y servicios turísticos
Campeche	El Remate	Ejido	Ejido	Milpa y apicultura
Campeche	Ich Haa lol Xaan	Cooperativa	Ejido	Milpa y apicultura
Campeche	Kakuxtal Much Meyaj	Cooperativa	Indefinido	Milpa y apicultura
Campeche	Muuch Kam	Cooperativa	Indefinido	Milpa y apicultura
Campeche	Colectivo Apícola de los Chenes	Cooperativa	Indefinido	Milpa y apicultura
Campeche	Toojil Xiimbal	Cooperativa	Indefinido	Milpa y apicultura
		28 organizations		

Sources:
Educación, cultura y ecología a.c.
http://educe.org.mx/?page_id=77
Programa de pequeñas donaciones PNUD
https://www.ppdmexico.org/mercadito
Cepeda, C. y A. Amoroso. 2016. Experiencias de desarrollo sustentable y conservación en la Península de Yucatán. The Nature Conservancy. 162 pág.
García de Fuentes, A.; Jouault, S.; Romero, D. 2015. Atlas de Turismo Alternativo en la Península de Yucatán. CINVESTAV-UADY, Ed. Primera. Mérida, Yucatán. 185 p.

- Explain collective value systems, such as customs, communal rules, and agreements for decision-making processes related to access and use of natural resources. (E.g. fishing schemes, land tenure rules and practices, water distribution systems and laws (including customary laws), forest management, seed exchanges, etc.)

Community access to natural resources: To regulate land use, there is the Agrarian Law. However, this law has been combined with the slash-and-burn system that does not favor land division because historically there has not been a continuous land use.

Another rule that has operated in land use is the "family milpa area," which is a form of "ownership" of the land by large groups of families. This is a custom that has its roots in pre-Hispanic times. This is practiced and accepted by all the peninsular Maya people as we told before in this section.

The guard system in the east of the peninsula requires that those who wish to have access to the use of common land must serve as soldiers. This is another historical community rule that has been merged with the Agrarian Law. In fact, it is the same principle that governs many other communities that ask young people to perform community service for land use rights.

Community agreements in forest *ejidos* and current milpa communities is a self-imposed agreement within the *ejido* to preserve forest reserve areas so that they can preserve forest reserve areas as part of a management plan, and maintain a supply of trees and wildlife.

These community agreements leave 1 km around population centers where milpas are forbidden. There are also regulations to preserve forested areas (*tolchés*) along roadsides and trails that surround the areas where maize is planted.

These self-limitations on milpa areas and forest preservation areas around towns are made despite the effects on the polyculture's productivity. Because of the age of the cleared land, productivity increases when the seasonal rains (those occurring from May to October) are delayed and behave erratically, which speaks of how important access to these forest resources is to *milperos*.

The processes that have caused a crisis in the milpa are the same ones that are causing important cultural changes in the life of Maya communities.

As for the milpa itself, multiple rituals associated with the different phases of the milpa cycle have been disappearing, partly because they no longer make sense: in milpas with reduced fallow, *milperos* no longer need to ask permission to clear the land and have become accustomed to not asking permission before burning, not to mention that in milpas with continuous occupation there is no slash and burn and it is no longer necessary to ask for this permission. The only rituals that are still practiced habitually are the *cháa chaak* or petition for rain, and the u *janli kool*, the gratitude for the harvest.

Respect for nature is preserved among adults,

PHOTO:THE NATURE CONSERVANCY

***J'MEN* OR MAYA PRIEST MAKING A *LOJ TO* HELP CURE A SICK YOUNG MAN. PHOTO: HTTPS://ALLTOURNATIVE.COM.MX/ RETRIEVED, AUG 2022**

but among children and young people it is being questioned, especially because it is being replaced by the scientific logic transmitted in schools, but also because parents and grandparents are breaking the transmission of the knowledge and traditions of the milpa.

Shotgun blessing, *loj tson*, is no longer carried out in many communities, in part due to the criminalization of this activity by the federal government, so it has been gradually taken away from the *milperos*. Beekeeping with the local *melipona* bee has also lost its sacredness if the activity is carried out for commercial purposes.

The Maya priests or *jmeno'ob* have played an important role in Maya communities because they performed most of the ceremonies and rituals related to the milpa and the supernatural beings of the forest.

They are the only people who remained after the disappearance of the ancient Maya hierarchy of high priests during the Conquest. Besides performing ceremonies, they also have healing abilities and use stones called sats or corn kernels to see what ails patients. They use herbs and prayers to cure these illnesses.

Sobadoras and midwives assist women during childbirth. Midwives attend births and *sobadoras*, or rubbing women, massage women to help put the baby in place before delivery. They also massage women after delivery because women often do very heavy labor and help put their internal organs in place so they can work. They are also very knowledgeable about herbal remedies.

It should be noted that there is a great deal of knowledge of herbalism in the area (see Section 3, Medicinal Flora).

The importance of traditional doctors and Maya priests or *jmenes* is also decreasing to where the services of *jmenes* are hardly required. Doctors have gained importance and the number of births attended by midwives and sobadoras has also decreased. Describe the Management of Transmission of Agriculture-Related Knowledge, Practices and Culture through Generations (e.g. through Community Leaders, Families, Women, etc.)

The cosmovision, religion, rituals, the milpa and the knowledge associated with forest management and related activities have been transmitted for millennia through oral tradition.

The role of parents and grandparents in this transmission has been fundamental, since they are the ones who have taught children and youth all the knowledge related to the forest, agriculture and cattle ranching that is required to carry out these activities. For this reason, they have a very important role in Maya society.

A good part of this knowledge through transmitted in the forest while carrying out various agroforestry

A WOMAN IN LABOR GIVING BIRTH WITH THE HELP OF A MIDWIFE.
DRAW BY: LEONARDO PAZ

HERBALIST HEALING A MAYA IN OXKUTZCAB, YUCATAN. DRAW BY: LEONARDO PAZ

activities. Another part is contained in the "stories" that grandparents tell their grandchildren. There are spaces and moments that are used for this transmission. For example, during the long preparations for the *ch'a chaak* ceremony and during vigils. Mothers tell stories and knowledge about animal and plant management on the plot, while making tortillas, while working on the plot, or while bathing the children.

This may seem simple, but the oral transmission from parents to sons and daughters has been indispensable for the survival of the culture, traditions and practices of the milpa for thousands of years.

The breaking down of this intergenerational oral communication is one of the most vulnerable aspects of knowledge that was created by the natural and supernatural relationship between nature and society, and culture may be lost.

IV 4.3. Contribution of Culture, Value Systems and Social Organizations to the Sustainability of the System

Awareness, involvement and contribution of local communities to the GIAHS application process and implementation of the Action Plan for Dynamic Conservation.

Multiple processes and cultural changes are threatening the traditional peninsular Maya milpa. However, there are also many positive processes.

It is important to consider the adaptations that have been observed despite the difficult situation of the milpa, such as the continuous milpa that has adapted practices to the current limitations, or the adaptations made to the farmer's commercialization system by introducing some of the milpa's products in the market to obtain monetary income (the most

successful case is beekeeping, but like we commented in previous paragraphs, it has also been done through the sale of products, cattle ranching, vegetables, handicrafts, tree felling or salaried work).

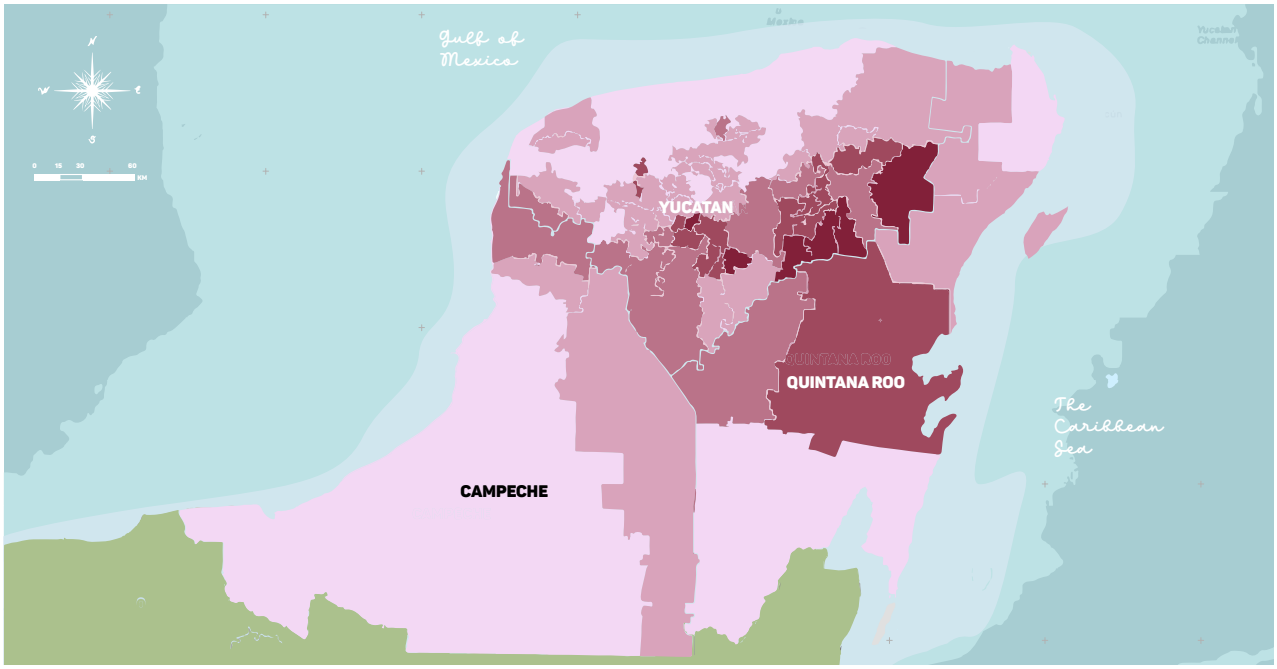
It is also important to highlight the role of milpa leaders and other allies who are supporting the conservation, adaptation, and development of the milpa.

To date, 776 *milperos* have signed and given their support to the proposal. They live in 60 different communities, in 14 municipalities, in the 3 states considered in the Yucatan peninsula.

MAYA SPEAKERS IN THE YUCATAN PENINSULA IN 1990. SEDUMA, 2016:80

INDIGENOUS POPULATION IN THE YUCATAN PENINSULA AND GIAHS CORE ZONE				
State	**Total population**	**Total indigenous population**	**GIAHS core zone population**	**GIAHS core zone indigenous population**
Campeche	928,363	91,801	100,853	40,559
Quintana Roo	1,857,9w8	204,949	129,468	69,480
Yucatan	2,320,898	525,092	919,673	388,032

Source: INEGI, 2020



MAP 9. MAYA SPEAKERS IN THE YUCATAN PENINSULA IN 1990. SEDUMA, 2016:80

SYMBOLOGY (%)

- 0%-7.5%
- 7.51%-31.59%
- 31.6%-51.76%
- 51.77%-69.45%
- 69.46%-85.99%

SOURCE: **INEGI. Census of Population and Housing 2000. Main results by locality (ITER)**
CONABIO (2010). distribution of the population in Mexico by municipality 1990. Geographic metadata cataglog.
GEOGRAPHIC PROJECTION. Universal Transversal Mercator Zone 16N. DATUM. WGS 1984

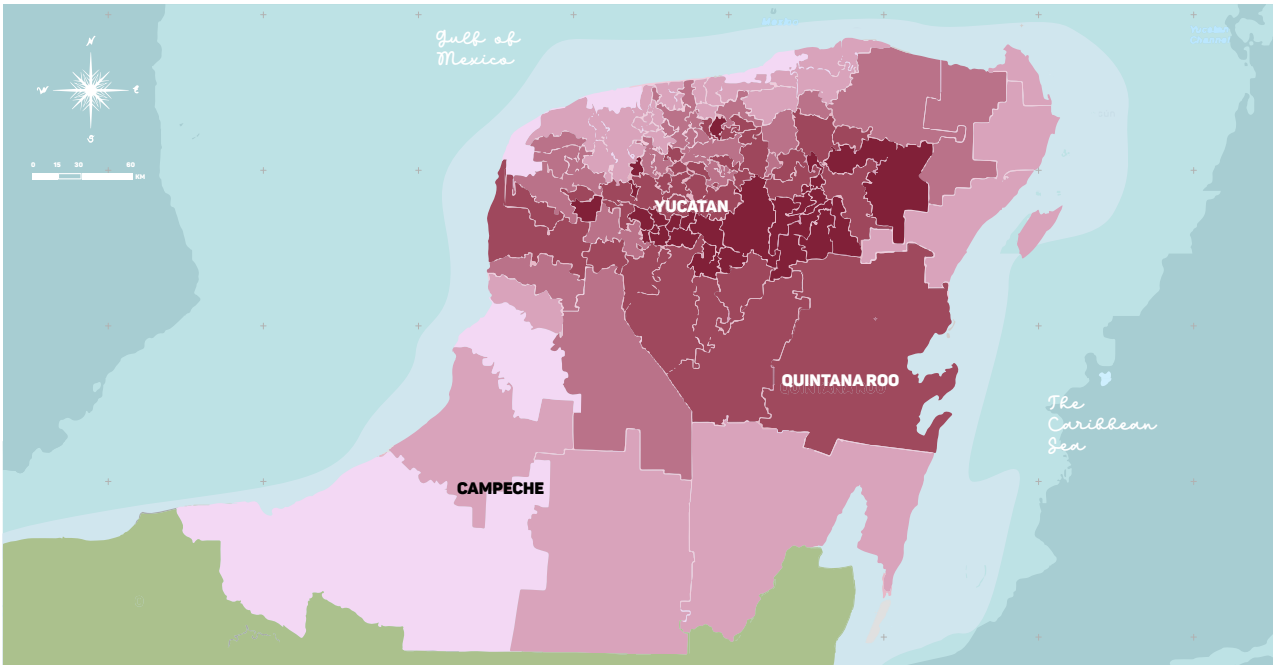


FIGURE 10. MAYA SPEAKERS IN THE YUCATAN PENINSULA IN 2010. SEDUMA, 2016:80

SYMBOLOGY (%)

- 0%-7.5%
- 7.51%-31.59%
- 31.6%-51.76%
- 51.77%-69.45%
- 69.46%-85.99%

SOURCE: INEGI. Census of Population and Housing 2000. Main results by locality (ITER)
INEGI. National Geostatistical Framework 2000
GREOGRAPHIC PROJECTION, Universal Transversal Mercator Zone 16 N.
DATUM WGS 1984

Individual *milperos* from other municipalities and communities, who are leading milpa best practices by integrating agroecological principles to intensify production, increase yields, conserve forests and improve seeds, are also willing to collaborate. These master *milperos* are working on seed improvement, cusodizing native seeds, experimenting with continuous milpas for better results, and are seeking alternatives to the *milpero* economy through sustainable forestry and cattle ranching management

Quintana Roo

Miguel Ku Balam: 997 128 4930

Campeche

Everardo Chablé, celular: +52 1 996 107 5098

Presidenta Elizabeth Haas Camas: +52 1 981 133 0456

Yucatan

Ubaldo Pat Dzib, celular: 985 107 5400

Idelfonso Yah Alcocer, celular: 999 241 3851

Civil society organizations (NGOs) conducting activities in this area recognize the value of this ancient practice more and more. They contribute by organizing and fostering relationships and exchanges between *milperos* and are contributing directly to replicating and preserving the Peninsular Maya Milpa (The Nature Conservancy, PRONATURA Yucatan Peninsula, World Wildlife Fund, Haciendas del Mundo Maya Foundation, Kellogs Foundation, Heifer Foundation, etc. contribute to this end).

Local universities and research institutions coordinate focal and regional efforts with an intercultural approach to promote and assist in the recognition of the Maya milpa. (Universidad Autonoma de Yucatán, Centro Regional Peninsula de Yucatán de la Universidad Autónoma de Chapingo, Centro Geo, Colegio de la Frontera Sur, Centro de Investigación Científica de Yucatán, Instituto Tecnológico Agropecuario unidad Conkal, Centro de Investigacion y de Estudios Avanzados del IPN Unidad Me´ridaUniversidad de Oriente, Universidad Tecnológica del Mayab, Universidad Interultural Maya de Quintana Roo, Centro Internacional de Mejoramiento de Maíz y Trigo, etc.).

International organizations providing technical and financial support to meet the objectives of the international environmental conventions and agreements. (FAO, UNDP, GEF, SGP, GIZ, USAID, GCF, etc.).

Federal, State and local **government agencies** are also contributing to support the proposal through public programmes. (Ministries of Environment and Natural Resources, Agriculture and Rural Development, Foreign Affairs, Welfare, Sustainable Development, Rural Development, Social Development, Culture, Institutes of Indigenous Peoples, Development of the Maya People, Intermunicipal Boards of the Puuc and southern Quintana Roo, etc.).

IV 4.4. Threats and Challenges

With the decrease of species and variants in the milpa polyculture, there are now fewer recipes being made using the ingredients found in the milpa and the culinary culture is also being eroded. This has also led to the deterioration of the population's health, as obesity and diabetes affect the Maya population significantly.

The Mayan language is also declining, as shown in the following tables:

Maya speakers in the Yucatan Peninsula in 1990, proportionally, in 20 years there was a significant decrease of 11.1% of the Maya-speaking population, although it must be considered that Quintana Roo has been a major center of migration of people from other states and this influences the percentage of non-Maya speakers.

Yucatan is the state with the most native Maya speakers, with 27% of its total population, and 65% of Maya speakers. Despite the decline, it is still almost a third of the population.

As for the Maya house, which was the predominant form of housing in the Yucatan Peninsula until the 1970s (63% of homes), by the early 1980s it declined drastically to 37% and by the early 20th century only 22% of homes were Maya houses. This trend has continued, along with the deterioration of several elements, and the substitution of thatched roofs for asbestos and cardboard sheets; the change of the elliptical base for a rectangular one; the substitution of liana ties for wire, cables and nails; and the significant reduction in the number of plant species used: for their construction, in 2011, only 29 species were used in their construction instead of the 45

A MAN IN THE MILPA. PHOTO:THE NATURE CONSERVANCY

reported for the 1970s. (Roman Kalish, A., 2014).

The reduction of these two indicators of ancient Maya culture: the Maya language and the Maya house, are very important to understand the cultural loss. However, other aspects must be considered, seeing that what is happening is a transformation of culture.

Festivities, unions, godfathers, the "Maya baptism" or *jeetz meek*, have been preserved, albeit with some modifications.

Two interesting adaptations of the *jeetz meek* are worth mentioning: First, it is still a tradition in the towns, and although they give the children books, computers, tablets or smart phones as gifts to encourage them to be good at working with these "instruments", they also continue to have the boys play the milpa tools, and the girls the comal and the sewing machine. Second, in the city some non-Maya people have adopted "Maya baptism" and give the babies a *jetz meek*, although they do not give them milpa instruments or sewing machines, they make them touch other equipment and tools that will give them skills for their future life.

The festival of the dead has also been changed because altars are now installed in schools and in the main square of the capital of Yucatán, Mérida; in addition, customs from other parts of the country have been introduced. However, this does not mean that there is a cultural loss. On the contrary, this tradition has been strengthened and has expanded to sectors that did not used to celebrate the arrival of the dead. But it must be recognized that the fact that the Day of the Dead has been recognized as an intangible heritage of humanity by UNESCO has favored its strengthening and even its expansion.

However, today, young women in towns and cities and from all social classes wear the embroidered hipil-style blouse worn with jeans, which they wear with pride as it reflects their regional traditions. Despite being immersed in a branded culture, young women wear the hipil blouse with great pride.

The conclusion is that it is necessary to find ways of transformation that allow the *milperos* to preserve the sustainable elements of the milpa and culture within the framework of the current global transformations.

5. Landscape and Seascapes Feature

Describe how landscapes or seascapes have developed over time through the interaction between humans and the environment and appear to have stabilized or developed slowly. Their form, shape and interconnections are characterized by a long historical persistence and a strong connection to the local socio-economic systems that produced them. Their stability, or slow evolution, is evidence of the integration of food production, environment and culture in an area or region.

IV 5.1. General Description of the Landscape

Description of the land use and landscape with visual materials such as figures, photos, and diagrams.

The Milpa landscapes, a mosaic of plant strata, are discontinuous areas of vegetation which have been modified due to agricultural use. They are composed of secondary plant communities in various stages of succession, which over time become secondary forests; and if conditions are favorable and encouraged, they can become restored as forests of native species.

In this case, the eradication of vegetation promotes a drastic change in the floral composition, which changes, and eventually becomes, restored forest land.

According to Gómez-Pompa (2000) this is a way in which man encourages the secondary vegetation species that he wishes to use, which also changes with the same succession. For example, among the first species that quickly inhabit a cleared area is the *tajonal* (*Viguiera dentata*), which is a very popular melliferous species. Similarly, the rapid proliferation

of some legumes as huaxin (*Leucaena leucocephala*) and other acacias improve the ability to support a few grazing animals. Over time, the fast-growing species are gradually outcompeted by the slow-growing vegetation, which will eventually establish itself as dominant, but maintaining a modified diversity that, according to studies, has survived for the last 600 years. (Gómez-Pompa and Kaus, 1999).

IV 5.2. Natural Biophysical, Abiotic, Climatic and Environmental Context

- Physical environment such as location of the area affected by the site, characteristic morphology, average slope, altitude.

Natural landscapes are related to the karst shell that forms the Yucatan Peninsula and the dissolution of calcium carbonate that occurs in the substrate through rain filtration. The dissolution results in the formation of cavities of different sizes, depths, and other karst formations that shape the landscape. We will refer to the most visible such as *cenotes*, caves, and *grottos*, and *rejoyadas* (circular, dried up wells).

Also, the Ticul Range, coastlines and mangroves make up other distinctive landscapes.

The Yucatan Peninsula is in the tropical zone with a predominance of warm climates (Aw and Ax) and dry climate in the northwest corner (Bw). There is no frost and between 1000 and 1200 mm of average rainfall is recorded with high relative humidity. Rainfall is distributed in a northwest-southeast gradient, so forests also have a similar distribution gradient. In the northwest corner where the climate is dry, the vegetation is mainly xerophyte plants. The annual temperature is 26 ° C. The prevailing weather and temperature favor pests in agriculture.

In summer and autumn tropical cyclones form in the Caribbean Sea and the Antilles, and occasionally hit the peninsula. Forest devastation from hurricanes and subsequent fires is an important part of the environmental constraints (Rodríguez, A., et al., 2016). In winter, cold air masses called “Nortes” enter from northern United States and southern Canada (Romero, D., s / f).

MANGROVES IN YUCATAN. PHOTO:THE NATURE CONSERVANCY

Besides erratic storms, critical and prolonged droughts, pests and hurricanes, soils have been a major constraint to agriculture. The Yucatan Peninsula is the youngest part of the country (13 million years) so soils are young, shallow, and stony, except in the south and east. The Peninsula is calci-morphous, as it is a plate formed of marine skeletons which have high permeability, so surface water is scarce, but there is access to groundwater through karst formations which have dissolved due to water friction, such is the case of cenotes, sinkholes and Aguadas, brackish ponds, (Teran, S. and Rasmussen, Ch., 1994).

“With an extension of 14,422,059 ha the Yucatan Peninsula is home to about 2500 species of plants, >3000 insect species, six species of ungulates, five felids, three primate species, 555 bird species, 24 species of amphibians, and 118 species of reptiles.

This provides a clear idea about the importance of biodiversity of the Yucatan Peninsula to the world, but challenge the needs to document the richness levels of other "highly diversified" components of biodiversity, i.e., invertebrates, fungi, and bacteria."

"Different forests and ecosystems cover the Yucatan Peninsula and provide habitat and protection for emblematic vertebrate species, such as the jaguar, tapir, howler, and spider monkeys, all of which represent essential components of the region's natural view."

"The principal types of vegetation are low deciduous forest; low semi-deciduous forest, with columnar cacti; low and medium semideciduous forest; high, medium and low semi-evergreen forest; high evergreen forest; savannas; palm groves; mangroves; coastal dunes; popales; tulles; and reed beds."

"Vegetation types are mainly distributed along a north-to-south precipitation gradient and according to different soil types, as well as precipitation variability in an east to west direction (Miranda 1958; Wright 1967). Tropical forest vegetation can be classified into two major groups with stand-specific associations, namely high and low forest."

Tropical forests or high forests, with canopy heights of over 30 m and three well-defined strata, are widely distributed across the Yucatan Peninsula. Low seasonally deciduous forests have canopy heights of less than 15 m and occurs in areas with annual precipitation varying between 600 and 800 mm or rarely more, located in the states of Yucatan, Campeche and Quintana Roo.

Mangrove wetlands dominate the northern coast of the Yucatan Peninsula. They are a part of coastal lagoons, marshes, and beaches. They highly depend on groundwater discharges. The interaction of wetlands with the mangrove in the Celestun-Palmar lagoon and in Dzilam lead to the development of forests with ecological characteristics similar to those found in deltaic and riverine coastal environments. The ecological regime of these sites combines the action tidal action and groundwater discharge. The vegetation is dominated by *Rhizophora mangle* (red mangrove, or *taab che* in Maya) and *Laguncularia racemosa* (white mangrove, or *sak okom* in Maya) (Zaldivar-Jimenez et al, 2010). It is estimated that approximately 70% of the organisms captured in the sea live at least part of their life cycle in a mangrove zone or coastal lagoon.

Among the many environmental services provided by mangroves are flood and storm protection, shoreline conservation, sediment retention, carbon sequestration, drainage of chemical wastes, sewage and solid wastes, recycling and maintenance of nutrients, and maintenance of water quality (Herzig, M., 2009).

Petenes

In the Yucatan Peninsula, fresh groundwater flowing through the interior of the peninsula toward the sea can sprout just before reaching the coast due to the hydrostatic pressure formed by springs. This favors the establishment of wetland ecosystems different from those produced on the coast, where high salinity water only allows the growth of shrubs and mangroves. Its vegetation is diverse, but they grow mostly forest species that are intolerant to high salinity like *Diospyros digna*, *cedar, chechem*, certain types of palms and balsa, among others. The vegetation that grows on these islands becomes denser and higher towards the center of the peten, favoring a concentric distribution of species according to their tolerance to salinity. In the core of the petén, the soil level is higher than in the peripheral zones due to an accumulation of soil formed by the decomposition of organic matter, a product of the same mass of trees. The diameters of the petenes found in the Yucatan Peninsula range from several tens of meters over 3 km. They are abundant in northwestern Campeche, in the Sian Kan Biosphere Reserve, Quintana Roo, and in Celestún, Dzilam Bravo and Río Lagartos in northern Yucatán.

- Other natural components of the system and their functions (watersheds, lakes, etc.)

Characteristic water bodies comprise significant elements of the landscape along with semi-permanent

MANGROVE ON THE COAST OF YUCATAN. PHOTO: ANDRES REYNOSO

AEREAL VIEW OF PETENES. PHOTO: HTTPS://ESCAPADAS.MEXICODESCONOCIDO.COM.MX/ RETRIEVED, AUG 2022

or cultural expressions that arise from their use due to the lack of common hydrological bodies (rivers) due to the karstic nature of the Peninsula. Some of the common water bodies in the milpa zone are the following (Duch, 1991, Duch, 2015).

Cenotes, or Sinkholes, are the most important among the karstic cavities. They are circular or elliptical depressions formed by dissolution. Their size varies from a few meters to 1 km in diameter and can be several hundred meters deep. Underground streams can become obstructed by clay, which makes water visible from the surface and are called karstic lakes. There are some on the peninsula that are visible from the surface, but the vast majority are underground and can be accessed through caves.

They have been vital in the life of the Peninsula to access water. We discussed that each *cenote* has its supernatural caretaker or owner and that they are invoked during the ceremony that asks for rain. According to Maya belief systems, the rain gods take water from *cenotes*, and it is important that the owners let them work. They are important elements of the landscape and are now one of the many tourist attractions of the region. In the northeastern region of the peninsula, there is a large concentration of them.

In the Maya zone, *cenotes* have undoubtedly influenced the population dynamics since pre-Historic times. In the absence of rivers and lakes, they were a decisive factor when populations decided where to establish their settlements.

The Maya milpa area covers part of "the *cenote* ring" and other hydrologic regions where groundwater is good and of acceptable quality for human consumption, this water can be accessed through natural or artificial wells or *cenotes*. It is common for towns and *caseríos* in the Yucatan Peninsula to have at least one *cenote*, which, most times, has some kind of construction so that they are accessible and there are rules for community use.

CENOTE IN YUCTAN. PHOTO: KAY VILCHIS

Caves and Cavernous Systems

They are very characteristic of karst relief. They look like a natural, empty underground channel. They can be simple or have very complex ramifications. They can form extensive underground galleries. Carbonated water results in the formation of stalactites which hang and stalagmites rising from the ground.

They have been an important part in Maya's life because there is evidence that ceremonies were held there and that, occasionally, during the "Caste War" people hid and lived there. Besides, they have inspired legends, and it is said that they are the abode of some supernatural beings and caretakers of the earth and animals, which, according to the Maya cosmovision, inhabit the Yucatan Peninsula.

Aguadas áak'al and chultunes

Aguadas make up a significant amount of surface

water bodies and their origin is attributed to the peninsular karst dynamic. Usually, the term applies to permanent water bodies that are on low land with an incipient slope, which allows for the circulation of groundwater above land. However, there are those who consider *aguadas* as concavities on the terrain formed from a preexisting depression due to a slight folding of the outer calcareous layers, which allows for the collection of rainwater through surface runoff of the peripheral areas.

There is evidence of the existence of pre-Hispanic hydraulic works, *chultunes*, in places where *cenotes* are not abundant or where the water table is too deep to get water from wells or groundwater, such as in the south of the peninsula.

These human works are called artificial aguadas to differentiate them from naturally ones. They were made

GROTTOES IN CAMPECHE. PHOTO: MARIGEL CAMPOS CAPETILLO

by building walls that lead rainwater to lower areas where it could be stored. During the dry season, when the *aguadas* lacked water, existence of wells or engineered underground reservoirs (they were bell-shaped, internally lined with rectangular rocks to prevent filtration) allowed inhabitants to satisfy their need for water. These types of adjustments are common in the southern state of Yucatan and northern Campeche, where groundwater is deep.

Currently, the use of natural *aguadas* as sources of water for human consumption is rather marginal, due to its increasing use as a drinking bowl for grazing cattle and / or small species. As for the artificial *aguadas*,

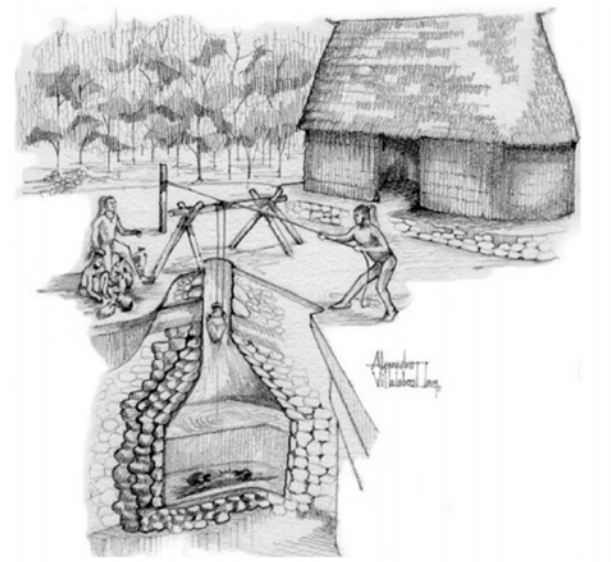
chultunes, these have fallen into disuse since the Spanish.

Lagoons, k'ob

These are on the borders between the state of Yucatan and Quintana Roo where their presence is associated both with the karst dynamics of the peninsular landscape and the tectonic manifestations of the geomorphological structure of the entity, as the fractures and/or faults that are deployed in the different physiographic sub-provinces of the Peninsula.

The main lagoons are in Cobá, Chichankanab (which means small sea in Mayan) and Esmeralda; they are long and narrow bodies of water, the last two very close to each other, in the limit that separates the Carso and Lomerios subprovinces in Campeche and Carso in Yucatán. Although there is no precise information on the water quality of these lakes, apparently, they are brackish and are not recommended for human consumption.

Floodable Lowlands, *'aak'alche'* and Raised Agricultural Fields



PRE-HISPANIC DRAWING OF CHULTUNES USED TO CAPTURE RAINWATER. PAINT OF VILLALOBOS A

Flooded lowlands are manifestation of surface hydrology, they are referred locally by their Maya term aak'alche which derives from *áak'al*, meaning aguada and che' meaning tree; therefore, it could be translated as "tree-lines *aguada*".

They are large depressions, originally covered with tree vegetation, whose lying slopes between their edges and lowest areas give the appearance after being cleared of extensive plains, especially in the dry season. However, the slope suffices to allow the collection of rainwater that runs off the surface during the regular rainy season.

The impermeable layer of the calcareous subsoil prevents the accumulated water from draining from the surface to the subway drainage system, which causes the appearance of a high-water table, which appears the circulation levels of the aquifer with a different and relatively independent dynamic. The permanence of the water mass is explained first, because in these depressions, the movement of water through the soil is very slow, since its clayey, expandable, and fine texture makes it practically impermeable; and second, because the depression formed transposes the upper groundwater level.

There is evidence of the pre-Hispanic use of these bodies through what we know today as "elevated fields". Intensive agriculture was practiced here during the classic period. Later, they were used for sugarcane production in some places, and for log wood extraction (*Haematoxylum campechianum*) in Campeche. They are not considered good soils for agriculture and milpa is not practiced on them. When drained, they look like large plains with few stones, which might seem like they would be good for mechanized agriculture, but this has not been successfully implemented due to soil conditions.

These floodplains are found in small portions of southern Yucatan, but mainly in Quintana Roo and Campeche. As their name suggests, they form important areas of floodplains, with a great diversity of wildlife.

Rejolladas, k'oop or k'oom

Rejolladas are remarkably circular depressions that vary in depth. They are caused by concavities in the ground surface and are produced either by the collapse of an underground dome or by the dissolution of the superficial limestone substrate due to natural activity, continuing downward and laterally, which causes them to become deeper and wider with time.

The *rejolladas* have the shape of a truncated cone turned downwards, so that the upper diameter (mouth) is always larger than the lower (bottom); their steep slopes usually go from the surface downwards. At the bottom of the *rejolladas*, there are sometimes deep soils without stones because they are areas where the material dragged by the slopes accumulates. They differ from the *cenotes* and springs because they do not store water despite receiving considerable volumes during the rainy season.

The largest are concentrated in the south and east of the peninsula. In pre-Hispanic times, their humid soils were used to plant cacao. Subsequently, they have been used to plant fruit trees.

Drains, *x'uuch*

Drains are fissures in the bedrock or on natural wells that are formed in some parts of the floodable lowlands. Through these fissures, rainwater that accumulates in these areas because of the runoff from the higher area's filters into the groundwater network quickly, as its name implies.

They are circular formations of small diameter that allow the evacuation of large volumes of water, similar to the drainage of a swimming pool or any other water reservoir.

According to information, sinkholes are formed when the weight of water accumulates on the surface of low floodplains, breaks the calcareous structures and opens access to the aquifer. Sometimes, dry leaves and other organic debris clog these drains, causing large volumes of water to accumulate. When they are

REJOLLADAS IN YUCATAN. PHOTO: PHOTO: HTTPS://WWW.ASOCIACIONTIKAL.COM/ RETRIEVED, AUG 2022

1

1 https://www.asociaciontikal.com/simposio-19-ano-2005/28-rocio-05-digital-doc

unclogged by the weight of the water, a tremor is produced, accompanied by a powerful sound, which can resemble a minor earthquake.

Dried out pools, *sartenejas*, or *jaltunes*

Sartenejas are indentations of varying shapes and sizes presented in some places with limestone surface (compact limestone). The Spanish name *sarteneja* probably derives from sarten which means pan, because of its resemblance to this cooking utensil; In Maya, it is called *jaltún* which means hole in the stone.

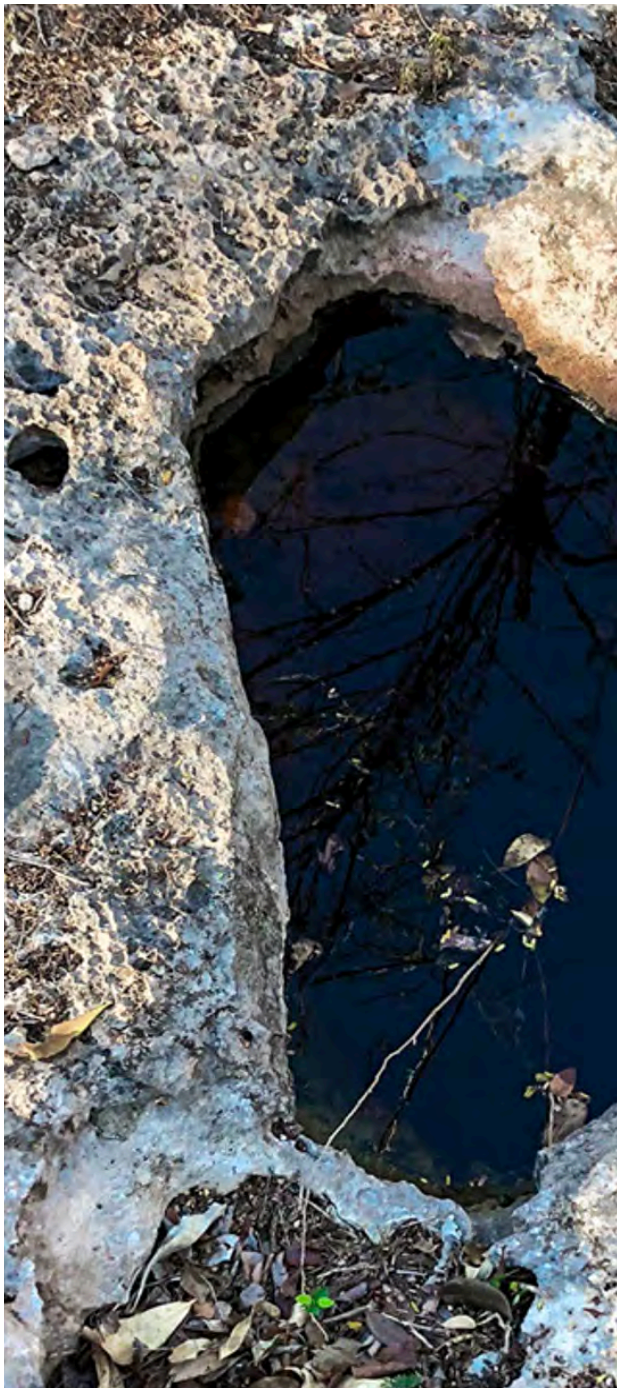
In these *sartenejas* rainwater is stored, where it remains for some time, and is used by the people in a variety of ways, including the preparation of food for the traditional drink called pozole (*k'eyem*). Although their origin is attributed to natural processes of dissolution of the limestone by rainwater, many others appear

DRAINS, *X'UUCH*. PHOTO: HTTPS://YUCATANTODAY.COM/ RETRIEVED, AUG 2022

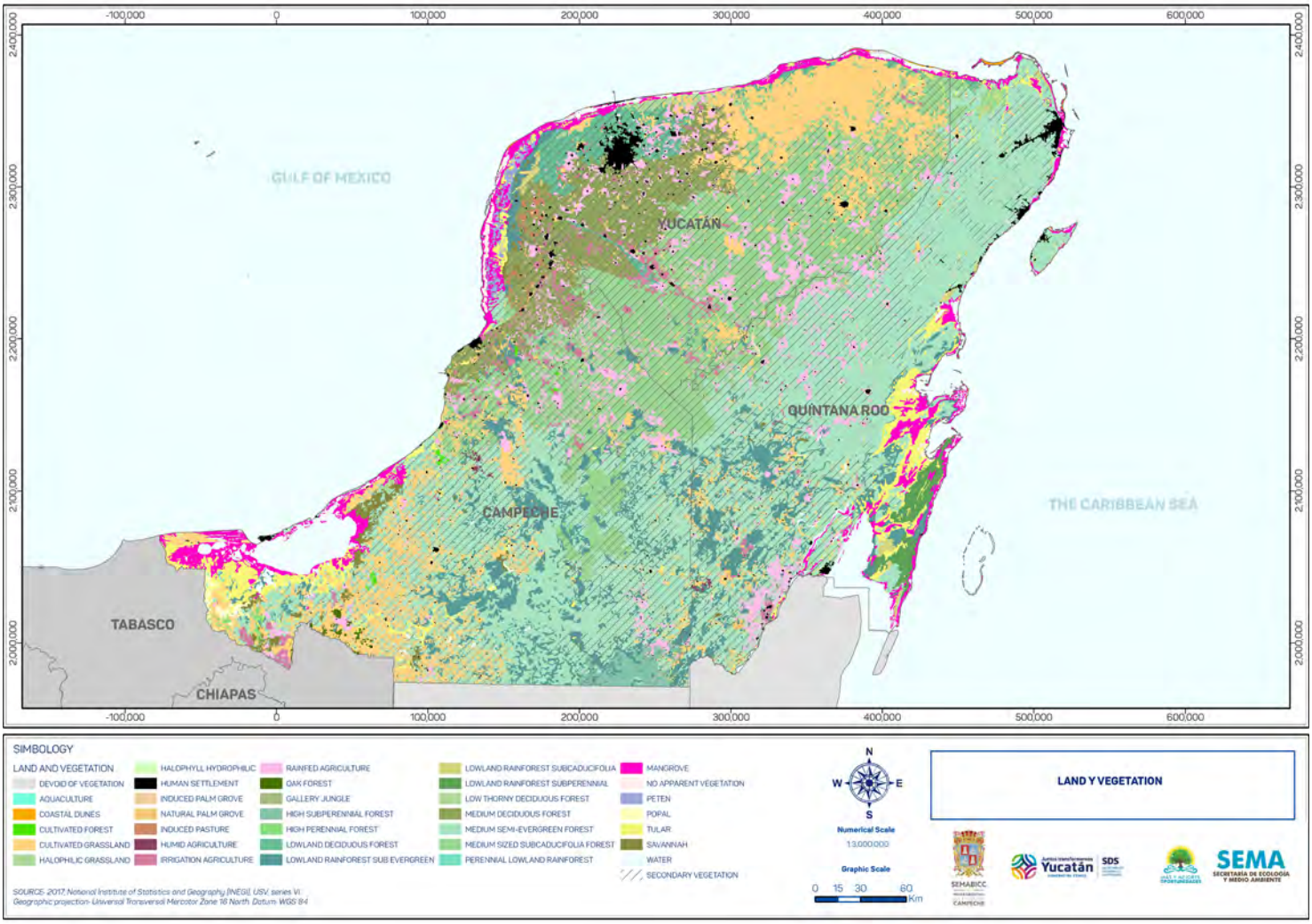
to be artificial, especially those near places where there are population settlements.

In the milpa zone, the *sartenejas* are one of the most important components for the milpa, as it is the major source of water for the *milperos* while they work. Land animals, birds and bees also come to drink from them.

A WOMAN STANDING NEXT TO A SARTANEJA. PHOTO: HTTPS://YUCATANTODAY.COM/ RETRIEVED, AUG 2022



DRIED OUT POOLS, SARTENEJAS, OR *JALTUNES. PHOTO: HTTPS://YUCATANTODAY.COM/ RETRIEVED, AUG 2022*



MAP 11. LAND VEGETATION MAP

AERIAL PHOTOGRAPHS OF 3 MILPAS IN TAHMEK, YUCATAN, READY TO BE PLANTED. PHOTOS: SEBASTIEN PROUST

IV 5.3. Agricultural Landscape and Seascape

- Map highlighting all relevant land uses related to agricultural activities including cultivated lands, pastured woods, grasslands, wetlands, swamps, water bodies, forests, urban areas and scattered settlements, agricultural arrangements (e.g., terracing, dry stonewalls, water courses, hedges, tree rows, etc.)

Relevant land uses related to agricultural activities and urban spaces are:[1]

Moisture Agriculture

This type of agriculture is distributed in central and coastal areas of the peninsula, areas where the soil moisture is used, regardless of the rain cycle and that even in the dry season conserve moisture, for example in flooded areas, such as riverbeds of reservoirs when they cease to have water.

Irrigated Agriculture

These agrosystems use supplementary water for the development of crops during the agricultural cycle, so their definition is based mainly how the water is applied, for example, sprinkling, dripping, or any other technique, being applied in different areas of the Peninsula, distributed between the center, north and south.

Rainfed Agriculture

Rainfed agriculture is classified as all those lands in which the vegetative cycle of crops depends on rainwater, so its success depends on the amount of rainfall and the soil's capacity to keep water, its classification is independent of the time the crop remains in the soil.

Cultivated Pasture

System in which native grasses from different parts of the world have been introduced intentionally in a region and for their establishment, under a productivity and conservation program, some cultivation and management tasks are carried out. Its distribution is mainly in the northeastern region of the Peninsula.

Cultivated Forest

It is established through the planting and management of different tree species for productive purpose, especially in those areas that present a disturbance due to human activities. Occasionally, they can be artificial forests, since they are the consequence of reforestation with trees of different kinds. These relics are found mainly in the southeastern regions and some in the center, mainly associated with forestry projects.

Urban

This land use is associated with the demographic conglomerate, considering elements and material works that comprise it. Urban expansion has been a key factor among the threats to diverse plant communities, given that it ultimately leaves extensions devoid of vegetation, many times of native species.

- System affects on the landscapes: how inherited practices for agricultural production and related resource management have shaped and changed the landscape. This part must highlight the value of agricultural activities in the landscape's evolution and explain any characteristics of uniqueness.

The landscape that has been formed by the *milpero* management is a forest-mosaic formed by patches of vegetation in different stages of the vegetal succession

1 Source: (INEGI, 2017)

and milpa plots interspersed in different phases of its cultivation. It has been as a large vegetable blanket with square or rectangular patches of regenerating forest in different phases. And where new and burned milpas appear, limestone soil and stone outcrops can be seen.

This landscape, although apparently monotonous, because it appears as a large forest, is actually very dynamic because all the milpa fields are abandoned while others are opened to cultivation. To see these layers of vegetation, it is necessary to climb to the top of the pyramids of the area. Actually, from the ground level there are no differences in the landscape due to the absence of mountains, except for the south and southwest of the Peninsula, where the Sierrita de Ticul in Yucatan and the Sierra de Hopelchén in Campeche are located.

However, at present, in those parts where continuous milpa is cultivated, only two separate and contrasted landscapes are formed: those formed by the forest and the extensions of milpa with their crops and which maintain important stability, if we compare them with the changes observed in the itinerant milpas.

Since the last 20 years of the last century, the continuous and itinerant milpas have been joined to the agricultural landscape by fields sown by industrial agriculture and cattle ranching, which expand at the cost of eliminating the forest permanently and increasingly leaving only large agricultural or cattle ranching fields without surrounding forest and in which one can observe furrows, soil worked with tractors and other machines. The pollution of the fragile peninsular soils and groundwater caused by the large-scale use of agrochemicals in these activities is not visible to the naked eye. These landscapes exist mainly in southern and eastern Yucatan and Campeche.

- In case of a seascape, it explains the unique features.

IV 5.4. Settlement and Built Landscapes: Main Traditional and Associated Types of Buildings

A TRADITIONAL MAYA HOUSE. PHOTO: GILBERTO M. GONZÁLEZ KUK

Applied knowledge and practices for land management, e.g land distribution, terraces, etc.

Traditional houses, urban gardens and *albarradas*. It has been mentioned that an important cultural element is the traditional Maya house with an elliptical base and thatch-roof of straw or palm. Now they have been included in the cultural landscape because when one visits the towns of the Peninsula, many of these homes can be seen surrounded by their plots and albarrada-style walls, especially when homes are far from the town center.

AERIAL PHOTO OF MERIDA WITH URBAN ORCHARDS. PHOTO: HTTPS://CONGRESOMUJERESPOLITICAS.MX/ RETRIEVED, AUG 2022

Around milpas, *ejidos*, *cenotes* and ranches, strips of arboreal vegetation (*tolches*) of different widths and lengths are left to shade and protect these places. They play an important role, like a source of local germplasm (Cob and Arias, 1998).

Urban orchards, once common land, are now disappearing. But they can still be found, especially from an airplane when flying over Merida, for example, the blocks that have an arboreal mass in the center of the block is because the orchards at the back of the home meet at the center of the block.

Churches and convents in Yucatan were built mainly by the Franciscans, and, for this reason, the buildings are not extravagant. They are sober, and sometimes, monumental buildings. Mostly they are in the main square of towns and cities facing west.

Among the most outstanding are the Merida cathedral dedicated to San Gervasio and the churches of the

Santa Ana, Santiago, and La Ermita de Santa Isabel neighborhoods

In Valladolid, the church and convent of San Bernardino of Siena and the central church stand out. In Izamal, the convent is built on top of a hill. In Mani, the church and convent are renowned historical site because it was here where Fray Diego de Landa ordered the burning of Maya codices in the 16th century in his fight against idolatry. The church in Uayma has a facade decorated with rosettes, a two-headed eagle and was recently rebuilt.

In many towns, especially the east, churches were destroyed during the Caste War of the 19th century in which the Maya fought against the white population. It is possible to see the ruins of these churches.

Haciendas. In the mid-19th century until the mid-20th century, the state of Yucatan was one of the richest states in the country due to the "green gold", henequen or Agave fourcroides. This plant was cultivated by the Maya. They built a commercial empire from the export of this plant. Henequen was cultivated in large plantations which had a house for the hacienda proprietor, or hacendado, and his family.

Many *haciendas* were built and are now part of the cultural and historical landscape of Yucatan. Some

CONVENT OF MANÍ, YUCATÁN, WHERE FRAY DIEGO DE LANDA ORDERED THE BURNING OF CODICES IN THE 16TH CENTURY. PHOTO: HTTPS://LAREVISTADELSURESTE.COM/ RETRIEVED, AUG 2022

of the most well known are Hacienda Yaxcopoil, Hacienda Temozon (President Clinton stayed here in 1993), Hacienda Mucuyché, Hacienda Tabi, Hacienda Santa Rosa, etc.

They were in ruins for many years, but in recent years, many *haciendas* have been restored and rebuilt by wealthy investors who turn them into hotels, restaurants, social event venues, etc.

Maya Vestiges of the Yucatan Peninsula are among the most recognized monuments in the Yucatan peninsula. They are the mark left by the ancient Maya civilization which could grow and prosper thanks to a complete diet provided by the milpa.

Among the most popular are Chichen Itza, Dzibilchaltún, Uxmal, and Ek Balam in Yucatan, Cohunlich and Tulum in Quintana Roo, and Calakmul and Edzna in Campeche. However, there are hundreds of sites that were inhabited by the Maya, most of which are still in ruins because excavation and restoration of these sites is very expensive, so most of these remains are left among the vegetation of the Maya jungles and forests.

HACIENDA IN SOTUTA, YUCATÁN. PHOTO: GILBERTO M. GONZÁLEZ KUK

FIVE STORY BUILDING, EDZNÁ, CAMPECHE. PHOTO: GILBERTO M. GONZÁLEZ KUK

TEMPLE OF THE SEVEN DOLLS, DZIBILCHATÚN, YUCATAN. PHOTO: GILBERTO M. GONZÁLEZ KUK

IV 5.5. Sustainability and Resilience

- Roles and functions of landscapes and seascapes management practices that help address natural constraints, e.g. erosion, floods, droughts, etc.

Despite the high economic vulnerability of milpa families (50% of *milpero* households do not reach the minimum welfare line), the peninsular Maya milpa represents a viable socio-economic option.

Maya milpa still occupies 55% of the agricultural area of the Yucatan Peninsula. Despite the reduction of milpas and the erosion of cultivated plant genetic resources, 55% of milpa value comes from the associated crops, reflecting genetic diversity and the importance of this diversity. There is also evidence of places where erosion of food plant genetic resources is less than 50%. Crops such as beans and tubers are grown on forest soils. In secondary vegetation crops no longer grow as well and the crop diversity begins to decrease. This is due to the better fertility provided by a forest than by secondary vegetation.

Secondary vegetation provides important environmental services, including CO_2 sequestration. This secondary vegetation highly depends on the Maya *milpero* population as revealed in a CRUPY study, and there is a correlation between secondary vegetation, Maya population, and milpa population (See Anexx 7) ere are benefits derived from the best milpa practices (See IV 1.3.) that can still be promoted further. System burns, guardrails and *tolchés* have traditionally prevented the spread of fires, when dry matter is large after hurricanes. We believe that all this makes the Maya milpa a good GIAHS candidate.

IV 5.6. Threats and Challenges

"In a broader context, global environmental change could provide an important context for current research on biodiversity conservation in the Yucatan Peninsula. Global change is causing both long-term changes in average conditions like potentially dramatic changes in environmental variation."

"The still extensive forested areas of the region result from dynamic vegetation processes strongly influenced by an intricate history of human and natural disturbances that can be traced back to the Classic Maya occupation period, when high population densities led to intensive activities that transformed landscapes. After the decline of the Classic Maya era (ca. AD 250-850), which was characterized by widespread deforestation, forests recovered of lower population densities and influence of disturbance regimes (Calderón-Aguilera et al. 2012). Over the last century, human-environment interactions have significantly shaped current terrestrial systems in the area (Turner 2010). Some of the important historical factors that determined the current landscape configuration include formalized land tenure and political demarcation, expansion of modern agriculture, urbanization, land use and conservation policies, and population growth through migration and redistribution (Porter-Bolland et al. 2008; Turner et al. 2001)."

The traditional Maya Milpa, capable of sustaining entire families and generating surpluses to contribute to society through taxes or sales, went into crisis in the early 1970s.

The process that provoked the crisis was the decrease in the availability of forests needed for the milpa, mainly due to the growth of cattle ranching and the impact of population growth in these conditions of decreasing land. The use of forests with a shorter fallow period, necessary for them to recover all their fertility and to eliminate weeds, caused low yields and to compensate for this, *milperos* applied fertilizers and herbicides that required money. During this same decade, Cancun was born like a tourist destination, and labor was required for the construction of new buildings and infrastructure. This need was covered by the *milperos*. The monetization of the milpa economy and the loss of food self-sufficiency began.

Subsequently, the initial processes have further developed and deepened, mainly due to neoliberal government policies that do not support a development of the milpa economy. This is necessary to strengthen the food self-sufficiency of the *milperos* and society

and to bring to a more balanced social dynamic.

Productivity policies of the Mexican state have encouraged the use of agrochemicals and improved seeds, and have promoted the privatization of *ejidos* and the mechanization of agriculture based on improved and transgenic seeds, such as soybeans, in Campeche. These measures pollute the soil and the atmosphere, reduce regional genetic materials and favor the parceling and the dispossession of milpa land, which are concentrated into the hands of just a few producers. They support commercial cattle ranching and agricultural expansion that destroy ecological resources and continue to further reduce milpa lands.

These processes, together with an educational system that does not allow for sustaining the milpa or ensuring that Maya students can escape poverty, have led to the migration of Maya youth to tourist areas such as the Riviera Maya and Cancun, to other Mexican cities and, since 2000, to the United States. The abandonment of the milpa by young people is eroding the ecological and technical knowledge associated with it. Migrations have affected communities and the expansion of the media and large food and soft drink corporations that change food consumption patterns and favor malnutrition, obesity and diabetes. All of this culminates in increased dependence on money, poverty and loss of food security.

The current national government is implementing less aggressive policies towards milperos, trying to reduce the use of agrochemicals and promoting programs that benefit reforestation. The state government is also promoting policies that benefit milperos.

PHOTO:MARIGEL CAMPOS CAPETILLO

V. ACTION PLAN FOR DYNAMIC CONSERVATION OF THE MAYA MILPA

1. Current Threats to the Maya Biocultural Milpa System

Since 1970, the Maya biocultural system entered a critical spiral because of the advance of cattle ranching and commercial agriculture. These two processes have resulted in a progressive reduction of forests available for milpa use, and have forced a reduction of agricultural rest periods, thus, affecting fertility, and forcing farmers to compensate with fertilizers. The use of land that has not been given a complete rest period has a greater presence of pests and diseases, as well as increased plant competition, triggering the use of pesticides and herbicides. The need for money to buy agrochemicals along with population growth has forced the labor migration of the *milperos*. These factors, along with other changes such as ideologies transmitted by the media, in the schools, by consumerism, and the introduction of fast/junk food to the traditional diet, have eroded the Maya biocultural system which, consequently, faces huge challenges amongst which we can find:

1.1. High economic vulnerability among families in milpa communities (50% of *milpero* households do not earn the minimum wage).

1.2. Erosion of genetic biodiversity after replacing "local" with "improved" seeds, mechanized farming systems and transgenic agriculture systems that are not necessarily more productive.

1.3. Cultural and generational erosion due to weak generational transition of knowledge regarding the milpa and overall culture, emigration of youth, and lack of appreciation for the Maya bio-cultural

1.4. Increased drought events, impact of hurricanes and large variations in rainfall because of climate change.

1.5. Faced with this reality, the Maya *milperos* and society have not stood still. They have created adaptation and conservation strategies for the peninsular Maya milpa.

2. Opportunities

2.1. *Milpero* teachers (experts) lead by integrating better practices and agroecological principles to intensify production, increase yields, and conserve the forest.

2.2. There are adaptation experiences of the Maya milpa bio-cultural system, by inserting any of the constituent elements of the system into the market (beekeeping, vegetables, forestry) in order to make money for the family, while retaining the maize for family consumption and diversity of the system. The incorporation of women into activities that favor household monetary income, such as vegetable cultivation, meliponiculture and local gastronomy, is noteworthy. It is also necessary to highlight the impulse that young people are giving to community tourism.

2.3. Seed Fairs held every year since 2003, in different parts of the Yucatan Peninsula, led by Maya *milperos*, Guardians of Seeds and assisted by some civil and academic institutions which promote conservation and exchange of native seeds.

2.4. Participatory improvement of native seeds, conducted jointly by Maya *milperos* and academics in several communities.

2.5. There is a School of Organic Agriculture–U Yits Kaán–which trains Maya *milperos* to farm organic maize fields.

2.6. There is a regional germplasm bank.

2.7. There are CSOs supporting Maya conservation processes and seed exchange.

2.8. Academics make regional efforts to promote an intercultural approach and regonize the peninsular Maya milpa

2.9. The regional UNDP supports the processes

of the Maya *milperos* in their quest for adaptation and conservation of the peninsular Maya milpa.

2.10. The State of Yucatan is articulating an agenda for the milpa and is networking with Quintana Roo and Campeche regarding the framework of the CTC.

2.11. Best practices for the milpa have been defined with Maya milpa communities.

2.12. The current incoming federal government (2019), is in favor of policies that strengthen food self-sufficiency and small producers.

2.13. Yucatan State Health Secretariat's Milpa Diet Project under the "Zero Hunger" initiative.

ADDITIONAL EFFORTS

Program or Project	Responsible
TEEB AgriFood Initiative	Local and national academy funded by the Kellogg Foundation
B- GCF TASK FORCE	Yucatan Government
Agrobiodiversity Conservation	
Food Security Program	
Strengthening of Women Producers' Capacities	
Traditional Medicine Conservation Program	
Biopasos	Campeche Government
Project Improve and replicate local capacity building processes linked to value chains and networks in agriculture	
Forestry and other Land Uses GCF Task Force Mexico	
Agroforesty Experimental Modules Project	
Fire Prevention and Management Program of Campeche State	

Program or Project	Responsible
Strategy for Reducing Emissions from Deforestation and Forest Degradation (REDD+) of the State of Quintana Roo.	Quintana Roo Government
Investment Program for the Central and Southern Region of Quintawwna Roo.	
Strategic project for food security.	
Agricultural planning in the face of growing risks.	
Milpa Forest Landscape Strategy.	
Sustainable Maya Milpa Project.	
Strategy for the Conservation and Sustainable Use of Biodiversity in the State of Quintana Roo.	
Program for the Strengthening of the Gender Perspective Transversality.	

Program or Project	Responsible
Agrobiodiversity Program of Yucatan	Federal Government (CONABIO, IMSS, INPI, BIENESTAR, CONAFOR)
Traditional Midwifery Program	
Sembrando Vida Program	
Support for Sustainable Forestry	
Development / Productive Forestry Projects for Women	
Program for the Economic Strengthening of Indigenous Peoples and Communities	
Small Grants Program	PNUD
Sustainable Territories Program	TNC
Territorial Innovation Networks (RITER)	
Community-Led Conservation (CLC)	
PRONAII: "Building bridges towards the search for solutions to socio-ecological problems in the Yucatan Peninsula".	Geo Center

FLAMINGOS. PHOTO: MARIGEL CAMPOS CAPETILLO

3. Construction of the Action Plan for Dynamic Conservation of the mayan milpa (APDCMM)

Since the beginning of the process, the communities have been involved. The first step was to gather updated information on the milpa in 2000. Most of the information was from the 1980s and 1990s and a key question was the condition of the milpa in 2000. During this step, the researcher spent days in the community of Cancabchén and Chunkanán in the state of Campeche, Naranjal Poniente and Tixcacal Guardia in the state of Quintana Roo and Tohopkú and Xoy in the state of Yucatán, and walked three transects through the milpas of the region. Thus, information was collected directly from the milperos. In 2015, a first regional

workshop was held in Oxcutzcab, Yucatan, to share the experience of best milpa practices. For many, it was the first time that the milpa was the focus of a workshop.

The second process comprised dialoguing with milperos and milperas during native seed fairs in the Yucatan Peninsula in 2016. At each fair, a small table was set up to share documentation on what a GIAHS is. A dialogue was held with each visitor, mostly milperos, who attended to buy or exchange native seeds for the upcoming rainy season. The consultants saw the enthusiasm of the milperos interviewed for the idea.

With the confirmation of interest, the consultation process began. In June 2016, a regional meeting was held in Peto, Yucatan. Milperos from the region met to design the consultation process. A communication plan was decided. The milperos carried out the process themselves, presenting the GIAHS in their communities, and then collect the document with the informed consent or nonconformity.

The consultation material was then distributed, including the dynamic action plan, which was also translated into Mayan. A bilingual summary was also printed. Seven community promoter meetings were held a 2016 and 2017 to collect consent.

A final meeting was held in May 2018 to close the consultation process. A total of 771 signed consents were received, and no dissent was expressed.

The representativeness and support of our proposal results from a collective and articulated effort of multiple agencies, actors, dependencies and interested organizations, all of which work towards the common aim of achieving the recognition of the milpa maya as a GIAHS.

In such a way that the construction of the Action Plan for Dynamic Conservation of the Maya Milpa (APDCMM) as GIAHS, comprises a team work, bringing together a compilation of programs and actions carried out by each organization or group in favor of the conservation and strengthening of the Maya Milpa, through:

3.1. Since 2018, Regional workshops were held with the custodians of GIAHS to validate the proposal and articulate a Action Plan for Dynamic Conservation the peninsular Maya milpa, intending to present it to the FAO. It has 771 signatures of representatives of milpa communities.

3.2. Because of the workshops held, the pillars of the action plan were agreed upon, based on 10 objectives from which the proposed actions emanate.

3.3. In compliance with the comments received by FAO in December 2020, consultations were carried out among the states of the Peninsula, as well as with the different agents involved and the group of experts: Museum of the Maya World through Dr. Silvia Terán, UNDP, TNC, CONABIO, CentroGeo, UADY, IBERO and University of Michigan and milpa organizations such as Misioneros A.C., to gather input on the projects and programs they carry out and the investments in the system's conservation, as well as obtaining feedback for the construction of the plan.

3.4. At the beginning of 2022, an update meeting was convened in Oxkutzcab, Yucatan, with the representatives of the milpa communities of the three states of the Peninsula, to socialize the recognition proposal once again and get their approval.

4. General Aim

"To conserve and continue to develop, the agroecological and cultural experiences of the peninsular Maya milpa, driven by policies culturally appropriate to the milpa system, to recover self-sufficiency, ensure the conservation of biodiversity and rebuild the territory as a common good."

As mentioned, the collective vision is fundamental in this plan, which is why, after a great deal of work carried out from 2016, all the information that makes it up is condensed.

In view of this, by description, the matrix that represents the APDCMM comprises the following elements:

5. Milperas Organizations Objectives

1. Establish a governance entity that integrates a representation of the *milperos* farmers from each state of the Yucatan Peninsula.
2. Defense of the territory by the Maya communities in alliances with civil society organizations, academic institutions and governments of the Yucatan Peninsula.
3. Stop the erosion of the native phytogenetic resources of the peninsular Maya milpa, enrich them, protect them and promote their consumption, contributing to Food Sovereignty.
4. Avoid soil and water pollution.
5. Obtain monetary income through the activities of the *milpero* production system, maintaining its diversity.
6. Conserve, enrich and adapt the agroecological knowledge produced by the milpa management of the forest, recognizing the work of indigenous farmers, their biocultural expressions and the rituals that sustain the Maya milpa system.
7. Recover the loss of the philosophy, cosmovision and rituals that underlie the Maya milpa system and enrich them, adapting them to new situations.
8. Promote institutional coordination in milpa promotion policies and the change of regulations to the requirements and agrocultural practices of the milpa.
9. Strengthen the best *milperas* practices, promote them and adapt them in the different regions of the Yucatan Peninsula.
10. Recover, conserve and develop the so-called biocultural expressions of the Maya milpa system.

Integrating these specific objectives is to value, preserve and develop the biocultural heritage inherent to the Maya milpa and the social benefits derived from it, particularly for women and children, who are participants and actors in the life of the Maya milpa system, considering that it is made up by biological elements, ecological interactions, symbiosis and ecosystemic processes, interrelated with social issues of equal importance that provide additional public benefits to the Mexican and world population.

Integrating these specific objectives is to value,

preserve

and develop the biocultural heritage inherent to the Maya milpa

6. About the Action Plan

The action plan is presented through a matrix that combines distinct elements, which are explained below:

Timeframe: the implementation time of this APDCMM is expected to be 3 years, starting from the first year of the recognition of the peninsular Maya milpa as a GIAHS.

Budget: once GIAHS recognition has been granted, a consultancy is planned to establish the specific costs involved in implementing APDCMM. However, the Action Plan expresses a budget estimate based on the inputs received from the different stakeholders through a participatory mechanism in which the budget items that have been allocated for the conservation of the System, as well as similar actions and programs that have been carried out by the different stakeholders, were reflected. The budget estimate is presented at the end of each aim in the Action Plan matrix.

Source of financing: APDCMM 's actions and objectives are not unrelated to the current priorities of each of the agents involved (governmental and non-governmental organizations and milpa communities) and are even aligned with international goals for the conservation of agricultural and traditional systems. In this way, it ensures joint progress to achieve the objectives set, guaranteeing the financing of activities through programs already established or future programs that may be created because of the recognition, as well as access to funds and international calls for proposals.

Responsible parties:

The entity that coordinates and reviews compliance with the long-term action plan will be the GIAHS governance body. In the short term, the entity in charge of observing the implementation of the action plan and taking the first steps towards the GIAHS governance body, are the Secretaries of Environment and Sustainable Development of the three states of the Yucatan Peninsula. In broad terms, the responsible parties are expressed in 4 categories: governmental agencies, milpero organizations, academia and non-governmental organizations, which comprise the actors shown in the table below.

FAO Objectives:

The activities of the Action Plan were adapted and aligned to the three simultaneous objectives of GIAHS -FAO- being these:

A. Build capacity within local communities and national institutions to promote, pursue and ultimately achieve the shared aim.

B. Promote regulatory policies and incentive environments that favor the conservation, evolutionary adaptation and viability of the Maya milpa.

C. Take advantage of the global and national recognition of the importance of the Maya milpa and institutional support to strengthen its conservation and safeguarding;

It is important to point out that the APDCMM is susceptible to feedback based on the needs and requirements of the *milperos* in order to continue strengthening and recognizing the system.

Stakeholders with potential for funding are listed in the table below:

STAKEHOLDERS WITH POTENTIAL FOR FUNDING

Government agencies	
State	**National**
Yucatan	
• Secretariat of Sustainable Development • Secretariat of Rural Development • Women's Secretariat • The Ministry of Culture and the Arts • Secretariat for Research, Innovation and Higher Education • Secretariat of Social Development • Secretary of Health • Institute for the Development of Maya Culture • Museum of the Maya World	• National Commission for the Knowledge and Use of Biodiversity (CONABIO) • National Forestry Commission (CONAFOR) • National Institute of Indigenous Peoples (INPI) • Welfare Secretariat • The Ministry of Foreign Affairs • The Ministry of Agriculture and Rural Development (AGRICULTURA • National Women's Institute (INMUJERES) • The Ministry of Agrarian, Territorial and Urban Development (SEDATU)
Campeche	
• Secretariat of Environment, Biodiversity, Climate Change and Energy • Secretariat of Culture • Secretariat of Social and Human Development • Secretariat of Rural Development • Secretariat of Sustainable Development	
Quintana Roo	
• Secretariat of Sustainable Urban Territorial Development • The Ministry of Agriculture, Livestock, Rural Development and Fisheries • Secretariat of Social Development • Secretariat of Ecology and Environment • Biodiversity and Natural Protected Areas Institute	

Milpera Organizations
• 771 *milperos* representatives through associations: • Missionaries A.C. • Network of Environmental Services Producers “Ya’ax Sot’ Ot’ Yook’ol Kaab” A.C. • Maya Collective of the Chenes
Academy
• Autonomous University of Yucatan (UADY) • Yucatan Peninsula Regional Center of the Autonomous University of Chapingo. • Geo Center • Southern Border College (ECOSUR) • Center for Scientific Research of Yucatan (CICY) • Instituto Tecnológico Agropecuario Conkal unit (ITC) • Center for Research and Advanced Studies of the IPN Merida Unit (CINVESTAV) • National Autonomous University of Mexico (UNAM) • Universidad de Oriente (UNO) • Universidad Tecnológica del Mayab • Intercultural Mayan University of Quintana Roo (UIMQROO) • International Maize and Wheat Improvement Center • Iberoamericana University • The University of Michigan • Non-formal education instances as field schools

Non-governmental organizations	
National	**International**
• Intermunicipal Board of the PUUC Region (JIBIOPUUC) • National Council of Science and Technology (CONACYT) • Mexican Civil Council for Sustainable Forestry (CCMSS) • PRONATURA Yucatán Peninsula	• Food and Agriculture Organization of the United Nations (FAO) • United Nations Development Programme (UNDP) • Global Environment Facility (GEF) • German Society for International Cooperation (GIZ) • United States Agency for International Development (USAID) • Green Climate Fund (GCF) • The Nature Conservancy (TNC) • World Wildlife Fund (WWF) • Kellogs Foundation (WK) • Heifer Foundation (HF)

7. Action Plan Matrix

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
1	**Establish a governance entity that integrates a representation of the *milperos* farmers from each state of the Yucatan Peninsula.**	Integrate and empower the GIAHS governance entity[1] for the execution of the Action Plan.		X	X	X	X	X	X	Year 1
		Agree that the governance entity should be the link between *milperos* and governmental institutions.	X	X	X	X	X		X	Year 1
		Establish a solid mechanism for compliance with the Action Plan.		X	X	X	X	X		Year 1
		Agree that the governance entity will serve as a reporter of the Action Plan's results to stakeholders.			X	X	X		X	Year 1
		Socialize the Action Plan among the actors who implement and milperos.			X	X	X		X	Year 1
		Coordinate efforts with the governance entity and governmental institutions.	X		X	X	X		X	Year 1,2 and 3
		Promote the participation of *milperos* in decision making.		X	X	X	X	X	X	Year 1,2 and 3
		Collaborate with the governance entity for the creation of a media campaign on the recognition of the Maya milpa like GIAHS and disseminate the benefits of the recognition.			X	X	X			Year 1
		Strengthen the statistical database of parcels			X		X	X	X	Year 1,2 and 3

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
Estimated budget Budget to be defined through a technical consultation to be carried out once GIAHS recognition has been achieved.										
2	**Defense of the territory by the Maya communities in alliances with civil society organizations, academic institutions and governments of the Yucatan Peninsula.**	Strengthen the conservation and development of the *milpero* system.			x	x		x	x	Year 1,2 and 3
		Disseminate a catalog of good agronomic, consumption and spending practices that, in agreement with the population, allow for solutions to local production and food problems.	x		x	x	x	x		Year 1 and 2
		Contribute to the elimination of the agrochemical use in the agricultural activities of the *milpero* system.		x	x		x	x	x	Year 1,2 and 3
		Improve institutional cooperation to preserve the Maya milpa, an ancestral practice.		x	x	x	x	x	x	Year 1,2 and 3
		Generate mechanisms to strengthen ejido management of the land.		x	x	x	x	x	x	Year 2
		Review the operation rules of different programs to reorient their actions towards protecting the Maya milpa system.			x	x	x	x		Year 3

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
Estimated budget $86, 065.00 USD										
3	**Stop the erosion of the native phytogenetic resources of the peninsular Maya milpa, enrich them, protect them and promote their consumption to contribute to Food Sovereignty.**	Offer comprehensive education to the communities on production (agricultural practices), environmental (agrobiodiversity, soil, water and air) and health (diet, nutrition and exposure to agrochemicals) issues.	x		x	x	x	x		Year 2 and 3
		Preserve the biodiversity of the Maya milpa through the use of ecological integrity indicators.		x	x		x	x	x	Year 2 and 3
		Undertake actions to mitigate the climate change effects.		x	x	x	x	x	x	Year 1,2 and 3
		Protect local genetic resources of importance to the milpa aya to ensure Food Sovereignty.		x	x	x	x	x	x	Year 1,2 and 3
		Formulate an inventory of genetic resources of the peninsular mayan milpa.	x	x	x	x	x	x	x	Year 1 and 2
		Locate, collect and conserve the plants considered most important for the Maya milpa.	x		x	x	x	x		Year 2 and 3
		Provide technical support to strengthen the production of native seeds by *milperos*.	x		x		x	x	x	Year 1 and 2

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
Estimated budget $747,670.00 USD										
4	**Avoid soil and water pollution.**	Encourage the incorporation of appropriate eco-technologies, promoting the use of renewable energy.	X		X	X	X	X	X	Year 1 and 2
		Promote models that favor the cultivation of local species and varieties adapted to the region.		X	X		X	X		Year 1 and 2
		Strengthen existing best practices of the Maya milpa as soil improvement, agroforestry, fire management, etc.	X		X	X	X	X	X	Year 1,2 and 3
Estimated budget $500, 845.00 USD										
5	**Obtain monetary income through the activities of the *milpero* production system, maintaining its diversity.**	Make medium and long-term projections for the maize and milpa sector.			X	X	X	X		Year 1
		Develop capacity using social capital and innovation networks in selected communities.	X		X	X	X	X	X	Year 2
		Promote the integration of organic agricultural and beekeeping products in local, national and international markets.			X		X	X	X	Year 2 and 3

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
		Improve income capacity through the diversification of productive activities in the Maya milpa.	x		x	x	x	x	x	Year 2 and 3
		Strengthen the milpa as a self-sufficiency strategy.		x	x		x	x	x	Year 1,2 and 3
		Guide public policies to improve the socioeconomic conditions of the *milperos* and their families.	x		x		x	x		Year 1,2 and 3
Estimated budget $4, 383, 595.00 USD										
6	**Conserve, enrich and adapt the agroecological knowledge produced by the milpa management of the forest, recognizing the work of indigenous farmers, their biocultural expressions and the rituals that sustain the Maya milpa system.**	Encourage the use and exchange of native seeds among *milperos*.	x	x	x	x	x	x	x	Year 1,2 and 3
		Identify and make visible the threats and conflicts faced by the Maya milpa in order to decide for its sustainable management.			x	x	x	x		Year 1
		Develop a scheme to support planning for the integrity of the Maya biocultural landscape.		x	x	x	x	x	x	Year 1 and 2
		Reinforce the importance of local and indigenous knowledge regarding the sustainable use of the Maya forest.	x		x		x	x	x	Year 1,2 and 3

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
		Promote the creation of research entities to update agroecological knowledge of the Maya milpa.		x	x		x	x		Year 3
		Integrate and recover indigenous ecological knowledge, biocultural expressions and rituals that sustain and enrich the system.	x		x	x	x	x	x	Year 1,2 and 3
Estimated budget $ 1, 236, 909.00 USD										
7	**Promote institutional coordination in milpa promotion policies and the change of regulations to the requirements and agrocultural practices of the milpa.**	Promote Maya rituals to new generations and encourage their participation.			x	x	x	x	x	Year 1,2 and 3
		Promote alliances and exchanges of knowledge among ethnic groups for intercultural strengthening.	x		x	x	x	x	x	Year 1,2 and 3
		Recognize the women's work in milpa activities.	x	x	x	x	x	x	x	Year 1,2 and 3
		Include young people in the milpa labor.	x		x	x	x	x	x	Year 1,2 and 3
		Support reconciliation in milpa traditions across the generation transition gap.		x	x	x	x	x	x	Year 1,2 and 3
		Promote the Mayan language like Mexico's cultural heritage.	x	x	x	x	x	x	x	Year 1,2 and 3

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
		Promote the knowledge, philosophy and rituals of the milpa system in formal and non-formal educational institutions.	x		x	x	x	x	x	Year 2 and 3
Estimated budget $118, 960.00 USD										
8	**Promote institutional coordination in policies aimed at strengthening the milpa and adjusting regulations to the requirements and agro-cultural practices of the milpa.**	Promote policies and legal measures to protect native seeds, as well as to emerge and expand the market.		x	x	x	x	x		Year 3
		Develop public education policies aimed at integrating the knowledge of the milpa within the programs.	x	x	x	x	x	x		Year 3
		Strengthen policies related to ancestral ceremonies and rituals protected by the Law for the Protection of Mayan Language and Culture.		x	x	x	x	x		Year 3
		Promote coordination among government institutions at different levels to regulate and protect traditional milpa practices.	x	x	x	x	x	x	x	Year 1,2 and 3

Objectives Set by the *Milperos* Organizations		Actions	GIAHS-FAO Objectives Description			Responsible				Deadline
			Capabilities	Policy	Reinforcement	*Milperos*	Government Agencies	Academy	Non-governmental organizations (national and international)	
Estimated budget $272,034.00 USD										
9	**Strengthen the best milperas practices, promote them and adapt them in the different regions of the Yucatan Peninsula.**	Organize contests and prizes for the best and most diverse milpas.		x	x	x	x	x		Year 1,2 and 3
		Promote projects for the adaptation of plants to climate change.	x	x	x	x	x	x	x	Year 1,2 and 3
		Recognize, preserve and adapt the best agroecological practices of the ancestral *milpero* system.	x	x	x		x	x		Year 1,2 and 3
Estimated budget $ 198, 150. 00 USD										
10	**Recover, conserve and develop the so-called biocultural expressions of the Maya milpa system.**	Generate recommendations for the conservation policy of the biocultural heritage associated with maize and milpa in Mexico.			x	x	x	x		Year 2 and 3
		Raise awareness among governmental institutions about the integrity of the milpa system and its biocultural expression.		x	x	x	x	x	x	Year 1
		Promote educational and recreational visits to the mayan milpa landscapes as an awareness-raising strategy from a biocultural perspective.			x	x	x	x	x	Year 2 and 3
Estimated budget $250,000.00 USD										

[1] Governance entity: Inclusive and transcendent form of organization, made up of farmers from different milpa groups, as well as a representative of organized civil society, which will be responsible for ensuring compliance with the Action Plan and keeping it alive despite changes in government administrations, working together with the relevant stakeholders, but maintaining its autonomy in decision-making.

Glossary

Spanish	Meaning
Aguadas	These are rainwater accumulations in natural hollows of different sizes. Some conserve water throughout the year, especially those that reach the water table. They are a source of water for wild animals, domesticated animals and people. In Maya they are called áak'al.
Atole	Beverage made from maize flour or dough, which is dissolved and cooked in water. When prepared with tender maize it is called ak' sa'.
City counsils	Municipal government and administration entities established by the Spanish and still used today. They are also known as cabildos. During colonial times the members of these governing entities were appointed by the provincial governor; today they are elected by popular vote.
Balché	Ceremonial beverage made from the bark of the plant called balché (Lonchocarpus longistylus), after being cooked and strained, the honey is added.
Ejidal bank	Governmental financial entity that was established with the creation of the ejidos. In the case of Yucatan, under different names, it was responsible for organizing and financing the henequen activity and agricultural diversification activities.
Cabañuelas	It is a traditional process used to predict the weather behavior during the beginning of the year in order to make decisions for the different agricultural practices. Records are made of the weather behavior during the month of January, in various orderings of dates and times, and from there it is inferred what will happen in the other months of the year. In Maya it is called xook k'iin, which means "the count of the days".
Caciques	They were leaders and representatives of the pre-Hispanic indigenous communities, who received tribute for their maintenance and collected tribute for the lordship. They were also called señores principales. The figure and its functions were preserved until the 19th century, but increasingly weakened.
Heatwave	Period with high temperatures and low rainfall. It starts a few weeks after the beginning of summer, in the last two weeks of July and lasts an average of 40 days. It is also known as intra-estival drought and in Maya it is called tzáab, in allusion to the rattles of the rattlesnake.

Spanish	Meaning
Caserío	Settlement form of the ancestral Maya of the Yucatan Peninsula. They were scattered throughout the peninsular territory, integrated by 6 to 8 houses that did not form a town, but a “parcialidad” or “barrio”, according to the Spanish denomination. The concentration of the inhabitants of these “caseríos” or “parcialidades” into towns was one of the first actions of the Spanish to control the indigenous population.
Cenotes	They are natural cavities formed by the dissolution, by subway aquifers, of soft limestone rocks of karstic origin. At their bottom they accumulate water from subterranean currents and rainwater filtrations. There are open-air cenotes, formed by the collapse of the vault or roof, and subterranean cenotes, which are accessed through small cavities or through caves. They were and continue to be essential sources of water supply and recently have become important tourist attractions. In Maya they are called ts’ono’ot.
Cerros	They are karstic formations of smooth convex outline, with frequent rocky outcrops and abundant stone content on the ground surface. They vary between 30 and 150 m in height and define a complex topographic pattern due to their recurrent alternation with the flat areas that extend between them. In Maya they are called wiits.
Comissariats	These are small communities dependent on the municipal capitals. The head of the municipal district and its commissariats make up the municipality, as the basic entity of the public administration.
Maya cosmogony	These are small communities dependent on the municipal capitals. The head of the municipal district and its commissariats make up the municipality, as the basic entity of the public administration.
Maya cosmogony	It establishes that the Maya universe rests on a crocodile and that it has four corners, each one oriented towards a cardinal point and supported by a bacab, the world’ s pillar. It is a structure divided into three levels, the earth, generally represented by the crocodile’s back (itzam cab ain), the upper world (oxlahuntikú) and the underworld (xibalbá). The sacred ceiba (yaaxché) communicated the three levels. Man was first made of clay by three gods, but he fell apart; then seven gods formed him from wood, but he lacked a soul; finally, thirteen gods achieved the definitive creation, this time with maize grains. After the Conquest, the sacred ceiba merged with the Christian cross.

Spanish	Meaning
Maya cosmovision	The ancestral Maya cosmovision indicates that there are deities, among them are the Creator God (Itzamnaaj), the Mountain God (Yuum Kaax), the Maize God (Nal), the Rain God (Chac), the Sun God (K'inich Ajaw) and the Earth Fertility Goddess (Ix Chel), owners of everything, to whom it was necessary to ask permission and then to show gratitude, in both cases by means of rituals presided over by a Maya priest (jmen) as mediator between the deities and the Maya. The Spanish substituted the gods of greater hierarchy, for God, the Virgin and the Saints, and only the gods and supernatural beings associated with the forest and the rain survived, which were mixed with the ancient Maya cosmovision.
Shredders	Machines used to separate fiber and pulp from henequen leaves.
Productive diversification	Family or regional productive strategy consisting on the management of several economic activities. In the case of agricultural activities, it is expressed in the management of several crops; in milpa agriculture it also includes activities such as beekeeping, hunting, gathering, handicrafts, etc.
Ejidatarios	Members of an ejido, with rights to the use of the land and other resources and benefits of the ejido. They have a certificate of agrarian rights issued by the federal government.
Ejido	Group of producers who have land that they received from the federal government in a form of social property and who created a new ejidal population center or remained in their community. Their highest authority is the ejidatarios' assembly and they also have an ejidal commissariat and a surveillance council.
Maize	It is the tender maize cob used for the preparation of atoles, tortillas, pozole, pibil nal and boiled corn.
Encomienda	It was a community, part of a community or a group of communities that together with its territory were awarded to a Spanish conqueror for his personal benefit, in exchange for castilianizing and evangelizing the population, but mainly to charge tribute in kind or in personal services.
Estancias de cofradías	They were estancias awarded to The Republic of Indians, for cattle raising purposes. With the money obtained, they formed Cofradías (guilds) and from there they paid multiple community expenses such as the festivities of the patron saints or illnesses of community members.
Estancias	These were site allocations made by royal grants to conquerors and their descendants, for agricultural and livestock use. In Yucatan, cattle ranches were predominant.
Fajinas	Collective work carried out in the communities, organized by the municipal authority or by the ejido authority, to clean and protect land and facilities.

Spanish	Meaning
Haciendas	Large agricultural and agro-industrial production units that in Yucatan were mainly milpero-cattle and later became milpero-henequen.
Edible home garden	A space next to the house where forage, edible, medicinal and ornamental plants (trees, shrubs and herbaceous plants) are grown, and where domestic animals are also looked after. Its purpose is mainly for self-consumption.
Yucatec Maya language	It is a variant of the Maya linguistic family that is spoken quite similarly in the Mexican states of Yucatan, Campeche and Quintana Roo, as they have common rules for writing and pronunciation. It is the second most spoken language in Mexico, after Nahuatl.
Maya language	Large linguistic family formed by 30 languages that has speakers in Mexico, Belize and Guatemala. In Mexico it is spoken in the states of Yucatan, Campeche, Quintana Roo, Tabasco, Chiapas and San Luis Potosi. It has five language subfamilies (Ch'ol-Tzotzil, Huasteco, Yucateco, Chujeano-Kanjobal and Quicheano-Mameano), which themselves include several languages.
Karstification	It is the process of dissolution of carbonates from the limestone rocks of the Yucatan Peninsula by the action of subterranean water currents. It gives rise to the formation of caves, cenotes and sartenejas.
Agro-ecological management	Set of practices that consider the interaction and balance of the different components of the agroecosystem and that respect the environment and allow agrochemical-free production.
Maya people	They are a people, a culture and a civilization that developed and persists today in Mesoamerica, particularly in the Mexican states of Yucatan, Quintana Roo, Campeche, Chiapas and Tabasco, as well as Guatemala and parts of Belize, El Salvador and Honduras. They generated important astronomical and mathematical knowledge and were the only Mesoamerican people to produce a glyphic syllabic script.
Servants	They were in charge of the henequen haciendas and represented the owner. Later they were called administrators.
The Maya milpa	It is the associated cultivation of maize, beans, squash and other species, carried out by the Maya ethnic group in close relationship and use of the Maya Forest.
The Mesoamerican Milpa	It is the term used to designate the associated cultivation of maize, beans and squash, which is present throughout the Mesoamerican area, although in each region with different varieties and other crops, depending on the ecological and cultural conditions of every region.
Milpa	The word comes from the Nahuatl word milli, sown plot, and pan, on top, meaning "that which is sown on top of the plot". In Mexico, milpa is the name given to the place where maize is grown, alone or together with other plant species, regardless of the agricultural system used.
Milperos	Farmers who work in the milpa.

Spanish	Meaning
Monte	It is a portion of land provided with vegetation, in which there are wild animals and other resources that are exploited by the families milperas. In Mayan it is called k'ax and can be considered as a synonym of forest in any of its successional phases.
Municipalities	They are administrative entities made up of a municipal seat and commissariats that depend on it. Their authority is the cabildo or town council, where the municipal president is a member.
Nortes	The nortes, or winter rainy season, is a period from mid-November to February. It is distinguished by lower temperatures and the presence of some light rains that can last from one to three days.
Green Gold.	Name given to henequen due to the great wealth that its cultivation and the commercialization of its fiber generated during the second half of the XIX century and the first half of the XX century, to the extent that the Yucatan Peninsula was the richest region in Mexico.
Milpa-plot.	It is a portion of land on which there are milpas.
Neighborhoods	This was the name given to the group of people from the ancient pre-Hispanic caseríos, who were forced to gather in a town after the conquest. To this day the towns are divided into neighborhoods.
Yucatan Peninsula	It is the northern portion of Mesoamerica that separates the Gulf of Mexico from the Caribbean Sea in the southeastern corner of North America and the northern part of Central America, with a territory of approximately 181,000 km2. It includes parts of Mexico, Belize and Guatemala, and in Mexico is the region formed by the states of Yucatan, Campeche and Quintana Roo, which together have a surface area of 151,515 km2.
Peones acasillados	They were permanent workers on the henequen haciendas, who lived on the haciendas themselves and were bound by a system of debts.
Pibil nal o elote pibil	They are seasoned corn that are cooked underground, obtaining color, smell, texture and unique flavor, in addition to the fact that this procedure allows its preservation for up to ten days. Its elaboration is a ritual for the lords of the mountain and their caretakers, the aluxes. The corn cooked in this way was a precious offering for the Maya gods and, more recently, it was offered at the end of Catholic prayers. It is now preserved as a product of Yucatecan gastronomy, both in the cities and in the countryside.
Dynamic Action Plan	It is a document that establishes commitments and concrete actions by FAO, governments, institutions, organizations and local actors, at different levels and times for the strengthening of a GIAHS.
Planadas	They are flat lands of various sizes surrounded by higher or lower ones, which are associated to form different landscape patterns. In Maya they are called táax; they are dominated by deep and moderately deep soils called k'ankab, therefore these sites are also called k'ankabaloob.

Spanish	Meaning
Polyculture	It is a type of agriculture in which several plant species and varieties are established in the same plot, either in association, imbrication or relay, similar to the natural ecosystem diversity.
Pozole	Beverage made from boiled maize kernels, ground and macerated in water. It is a traditional drink, a fundamental part of the rural diet, which nourishes, refreshes and gives energy. In Maya it is called k'eyem; when prepared with tender maize it is called ak'alix.
Ejidal property.	It is a type of social land ownership granted by the State to a group of farmers. For their protection, it was established that they are inalienable, unprescribable and unseizable.
Distributions	These were concessions from the authorities of New Spain, to Spanish conquerors and some indigenous caciques, of a labor quota of workers from the indigenous communities for personal services and to work on plots of land and ranches.
Sacaj	Ritual beverage made from boiled maize macerated in virgin water from caves (sujuy ja', in Maya), similar to pozole but preserving the husk of the maize seeds. Sometimes honey is added.
Sartenejas	They are hollows of various shapes and sizes that appear naturally in the superficial calcareous rock, in which rainwater accumulates. They are useful for milperos and wild animals. In Mayan they are called jaltún.
Solar	The solar -tankab or kuch in Mayan-, together with the milpa and the mount, represents the other productive and reproductive space of prehispanic origin of the biocultural agro-ecosystem of the milpero. The milpero family lives and reproduces at the solar. A greater diversity of plants is grown there than in the milpa, some permanent, such as trees and shrubs, and others of diverse cycles, such as short-cycle maize, vegetables, medicinal, and ornamental plants. In the solar they also raise ancestral animals such as turkeys, meliponas bees and all those that were introduced such as pigs, ducks, cattle or European bees. Traditionally it has been organically linked to the milpa because the animals of the solar have been fed by the products that come from it. The nutritional and productive importance of the solar for the milpa family is that it offers complementary food resources, when the milpa produces well, and essential food resources,when there is a shortage. In addition, its products are interchangeable for products and money, it means that it constitutes a potential merchandise.
Maya Forest	It is the largest tropical forest in Mesoamerica and the second largest in America. It is distributed in the border area of Mexico, Belize and Guatemala. It has about 42,300 km2 and has about 20 ecosystems that harbor a great biological diversity and a large number of endemic species

Spanish	Meaning
Tamal	Word that comes from the Nahuatl tamalli, which means “wrapped”. It is a preparation based on maize dough, combined with chaya leaves or tender xpelon bean grains (Vigna unguiculata) or with pork or chicken meat, of different sizes, textures and flavors, which are wrapped with banana leaves or with the dried bracts of maize cobs and steamed. There are two types of tamales that are cooked underground, both with ritual uses, one to give thanks to the owners of the forest (called chachacua) and the other to offer to the dead (pibes).
Tok sel	It is a combination of ground squash seeds with tender beans called íib. First, the beans are lightly boiled with salt and epazote, the water is removed and the ground squash seeds, chopped chives and the stones that have been previously placed on the fire are added; the pot is covered so that the beans produce steam.
Tortilla	It has been and is the basic component of the Mexican diet and, particularly, of the indigenous population; in critical times or in conditions of extreme poverty, people eat only tortillas with salt and chili. For the peasants it is the food itself, but also the spoon, because they eat with pieces of it. It is made with nixtamalized maize that is ground and kneaded. Women prepare them with small portions of dough that they place on a piece of plastic or a part of a banana leaf and give them a flat and circular shape with the palm of one hand, then they spread it on a metal or clay comal that has been previously placed and heated with firewood in a stove formed with three stones. The tortillas can be of different sizes and thicknesses, although the most common has an approximate diameter of 15 cm. In Maya it is called waaj.
Tributes.	They were the basis of the pre-Hispanic and early colonial economic system. It consisted of the delivery of products and personal services to the caciques and later to the Spanish encomenderos.

BIBLIOGRAPHY

- Aban M., B. S/F. El Maíz y sus Prácticas Agrícolas en la Comunidad de: Xocén, Valladolid, Yucatán. Unidad Regional de Culturas Populares, Mérida, Mecanoescrito Unpublished
- Acosta D., E, G. Aguilar C., R. Ramírez T., M.A. Sanchez G., P. Uuh Ch., G. Uribe V., R. Navarrete O., J.M. Nusico, L.F. Zepeda A. E.
- Carvajal C., J.D. García P., G. Adame G., M. Cruz F., C. F. Mejía, 1984. La Milpa Sistema Tradicional para Producir Maíz Asociado con Frijol Ib y Calabaza en la Península de Yucatán. CIAPY. Mérida.
- Álvarez Sánchez, J. and Naranjo García, E. Editores, 2003. Ecología del suelo en la selva tropical húmeda de México, Instituto de Ecología A.C., Instituto de Biología y Facultad de Ciencias, UNAM. Xalapa, México
- Arias R., L.M., l980. La Producción Milpera Actual en Yaxcabá, Yucatán. E. Hernández X. & R.P. Ortega editors, Seminario Sobre Producción Agrícola en Yucatán. 259-302.
- Barrera M., A.V., A. Gómez-Pompa Y C. Vazquez-Yanez. 1977. El Manejo de las Selvas por los Mayas, Biótica, 2/2:47-60.
- Bautista, F., D. Maldonado, Zinck, A., 2012. Clasificación Maya de los Suelos. Ciencia y Desarrollo. UNAM. Vol. 38, No. 260. Pp. 64-70. México.
- Bauer, P., Wein, Gott, Gondwe, Bibi R.N., Charvet, G., Marín, L.E., Rebolledo-Vieyra, M., Merediz A. G., 2011. The Yucatan Peninsula Karst Aquifer. En Hydrogeology Journal. May. 2011. México.
- Becerril G., J., Francisco I. Hernández C., 2020. Apicultura: su contribución al ingreso de los hogares rurales del sur de Yucatán. Península. Vol. 15. No.2. UNAM. México. http://www.revistas.unam.mx/index.php/peninsula/article/view/76597
- Bezaury C., J. E. Graf M., S., Karla B., K., De La Maza H., R., Machado M., S., Rodríguez M. Del S., E., Rojas G. De C., S., Ruíz B., H., 2015. LOS PAISAJES BIOCULTURALES un instrumento para el desarrollo rural y la conservación del patrimonio natural y cultural,
- Boege Smith, E., 2008.El patrimonio biocultural de los pueblos indígenas de México. INAH y Comisión Nacional para el Desarrollo de los Pueblos Indígenas. México.
- Bracamonte, P., 1994. La memoria enclaustrada: Historia de los Pueblos Indígenas de Yucatán 1750-1915. CIESAS-INI. 253 p. 3 Vol. México.
- Bracamonte y S., P., 2007. Yucatán: Una Región Socioeconómica en la Historia. Península. Vol. II Num.2. Otoño 2007. Pp. 13-32. México.
- Briceño Ch., F. 2002. Lengua e Identidad entre los mayas de la península de Yucatán, Yucatán Identidad y Cultura Maya. Centro de Investigaciones Regionales Dr. Hideyo Noguchi, Unidad de Ciencias Sociales Dirección General de Desarrollo Académico Universidad Autónoma de Yucatán. https://www.mayas.uady.mx/articulos/lengua.html
- Colunga G.M., S.P., 1984. Variación Morfológica, Manejo Agrícola y Grados de Domesticación de Opuntia spp. en el Bajío Guanajuatense. Tesis de Maestría en Ciencias. Especialista en Botánica. Colegio de Postgraduados México.
- Canul N., Fátimo, 2016. La milpa actual de Xócen-Kaj: los conocimientos y saberes ancestrales heredados. Presentation. Terceras Jornadas sobre el Sureste de México, Centroamérica y el Caribe. Universidad de Oriente. Valladolid. Julio. 16 p.
- Cantón R., F. A., 2016 Aportes alimentarios y nutricionales de los sistemas productivos tradicionales a la dieta en Tixcacaltuyub,

Yaxcabá, Yucatán, Tesis de Licenciatura en Biología. Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Yucatán, 84, Yucatán México.

- Caamal Itzá, B. 23 de mayo de 2015. El blog del Arux. Obtenido de https://culturamayahistoriasanecdotasyucatanmagico.wordpress.com/tag/hel on/
- Cervera M., M.D., 2008. El hetsmek' como expresión simbólica de la construcción de los niños mayas yucatecos como personas. Revista Pueblos y Fronteras Digital. La Noción de Persona en México y Centroamérica. Núm. 4, December 2007 – May 2008. http://www.pueblosyfronteras.unam.mx
- Chablé. S, J. y H, Delfín G., 2010. Uso tradicional de Fauna Silvestre. Pp. 377-381. Durán G., R. y Méndez G., M. E. (Editores.) 2010. P. 345. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA. 496 pp. Yucatán.
- Colunga, P. y F. May. 1991. El sistema *milpero* y sus recursos fitogenéticos. Zizumbo, D. et al. (Editores.). La modernización de la milpa en Yucatán: utopía o realidad. Pp. 99-134. CICY, México.
- Comisión Nacional Forestal (CONAFOR), 2012. Inventario nacional forestal y de suelos. Informe 2001-2009. Zapopan, Jalisco: Comisión Nacional Forestal. México.
- CONAGUA. 2021. Programa Hídrico Regional 2020-2024. Región Hidrológica-AdministrativaXII. Península de Yucatán. Secretaría del Medio Ambiente. CONAGUA. Amigos de Sian Ka'an, Consejo de la Cuenca de la Península de Yucatán, Fundación Río Arronte, Itaca Environmental. Agosto. México.
- De La Garza, M., A.L. Izquierdo, M.C. León, T. Figueroa editores. 1983.Relaciones Histórico-Geográficas de la Gobernación de Yucatán. 2 T. UNAM. México.
- Duch G., J., 2005. La nomenclatura maya de suelos: una aproximación a su diversidad y significado en el sur del estado de Yucatán. Geografía Agrícola (34), pp. 55-74. México.
- Duch G., J. 2022. Breves referentes de interlocución e intercambio de saberes entre estudiantes de agronomía y productores rurales en el estado de Yucatán. Manuscrito. Universidad Autónoma Chapingo, México. 25 p.
- Durán G., R. y Méndez G., M. E. ´(Eds.) 2010. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA. 496 pp. Yucatán.
- Dzib-Aguilar, L. A.; Ortega Paczka, R.; Segura-Correa, J. C., 2016. Conservación in situ y mejoramiento participativo de maíces criollos en la Península de Yucatán, Tropical and subtropical ecosystems, vol. 19, num 1, pp.51-59, Universidad Autónoma de Yucatán. Mérida, Yucatán, México. http://www.redalyc.org/artículo.oa?id=93945700002
- Fedick, S. ,1996. An interpretive kaleidoscope: alternative perspectives on ancient agricultural landscapes of the Maya Lowlands. pp. 107–31. S. Fedick (editor.), The Managed Mosaic. University of Utah Press, Salt Lake City. Agriculture and Resource Use, pp. 145–64. University of Utah Press, Salt Lake City.
- Flannery, K.V. 1973. The Origins of Agriculture. Annual Review of Anthropology. Pp. 271-308
- Flores G., J. S. Flora Melífera. Durán G., R. y Méndez G., M. E. (Editores.) ,2010. P. 345. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA. 496 pp. Yucatán.
- Flores G., J. S. Diversidad de plantas forrajeras en las comunidades mayas. Durán G., R. y Méndez G., M. E. (Eds.) 2010. P. 355. Biodiversidad y Desarrollo Humano en

Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA. 496 pp. Yucatán

- Flores G., J. S., 2012 Diversidad Florística usos y origen del material genético de las especies de los huertos familiares de la Península de Yucatán. R. Mariaca M. Editor El Huerto familiar del sureste de México. Secretaría de Recursos Naturales y Protección Ambiental del Estado de Tabasco. El Colegio de la Frontera Sur. Pp.149-175
- Florescano, E., Quezada, S., Esma B., J., 2018. Atlas Histórico y Cultural de Yucatán. Secretaría de Cultura, Gobierno del Estado de Yucatán y Hermes. México. 526 pp. Unpublished.
- Ford A. and Emery, K. 2008. Exploring the legacy of the Maya Forest. Journal of Ethnobiology 28(2): 147–153
- García, A., S. Terán, Ma. D. Cervera, G. Cortés, A. L. Aranda, F. Chel B., I. Franco, C., 2018. Modernización Centralizadora 1955-1991. E. Florescano, S. Quezada, J. Esma B. Coordinadores. Atlas Histórico y Cultural de Yucatán. Pp. 296-329.
- García Quintanilla, A., La langosta, los mayas y el colonialismo en Yucatán, México, 1983. Relaciones 129, Winter 2012, 215-249, issn 0185-392. file:///G:/BIBLIOTECA%20 ELECTRÓNICA/García.%20La%20 langosta,%20lo s%20mayas%20y%20 el%20colonialismo%20en%20Yucatán,%20 México,%2 01883.pdf
- García Q., A. y Sánchez S., A. 2014. Introducción a las historias de la maya naj, Aurelio Sánchez Suárez y Alejandra García Quintanilla editores. La Casa de los Mayas de la Península de Yucatán: Historias de la Maya Naj. Unidad de Ciencias Sociales CIR-UADY, Facultad de Arquitectura, Universidad Autónoma de Yucatán y Plaza y Valdez Editores. Mérida, Yucatán
- Gerhardt, J. C. y Hammond, N., 1991. The community of Cuello: the ceremonial core. Cuello: an early Maya community in Belize, Cambridge University Press. Reino Unido pp. 98-117.
- Gómez-Poma A., et al. Editores. Traditional Knowledge of Plant Resources The lowland maya area: three millennia at the human-wildland interface. Food Products Press. pp 533-550. New York.
- Gómez-Pompa, A., Morales, H., Ávila, E. and Jiménez, J., 1982. Experiences in traditional hydraulic agriculture. K. Flannery editor. Maya Subsistence. Studies in Memory of Dennis E. Puleston. Academic Press, pp. 327–42, New York.
- Gomez-Pompa, A. and A. Kaus,1999 From pre-Hispanic to future conservation alternatives: Lessons from Mexico. Proc. Natl. Acad. Sci. 96 (5982–5986).
- González J., s/f. Los calales del suroeste de Tlaxcala. Una descripción del sistema en la cuenca del Río Zahuapan. Universidad Iberoamericana. 2i p.
- González-Cruz. G, E. García-Frapoli, A. Casas F., y J. M. Dupuy R. 2014. Conocimiento Tradicional Maya sobre la Dinámica Sucesional de la Selva. Un caso de estudio en la Penísnsula de Yucatán. En Etnobiología. 12 (1), 2014, pp 60-67. Dialnet.
- Güemes-Ricalde, F. J., Echazarreta-González, C., Villanueva-G, R., Pat-Fernández, J. M. y Gómez-Álvarez, R. 2003. La apicultura en la Península de Yucatán. Actividad de subsistencia en un entorno globalizado. Revista Mexicana del Caribe. 16. 117-132
- Hammond, N., 2008. Cuello: An Early Maya Community in Belize. Cambridge University Press.
- Harrison, P. 1996 Settlement and land use in the Pulltrowser Swamp archaeological zone,

Northern Belize. S. Fedick (ed.) The Managed Mosaic, pp. 177–190, University of Utah Press, Salt Lake City.

- Hernández Escobar, C. 1992. La milpa bajo roza-tumba-quema y su intensificación tradicional en el cultivo de conucos. D. Zizumbo Villarreal, C. H. Rasmussen, L. M. Arias Reyes y S. Terán Contreras editores., La modernización de la milpa en Yucatán: utopía o realidad. 281-29. Mérida: CICY, DANIDA
- Hernández Xolocotzi, E., 1959. La agricultura en la Península de Yucatán. E. Beltrán editor, Los recursos naturales del Sureste y su aprovechamiento, Tomo 3. Instituto Mexicano de Recursos Naturales Renovables. Pp.1-58. México.
- Hernández Xolocotzi, E., 1981. Prácticas Agrícolas. Várguez P., L. A. editor. La Milpa Entre los Mayas de Yucatán. Pp. 45 – 73.
- Hernández-Xolocotzi, E., 1993. Aspects in plant domestication in Mexico: a personal view. En Ramamoorthy, T.P., R. Bye, A. Lot y Fa, J. editores, Biological Diversity of Mexico, Origins and Distribution, 1a edición, Oxford University Press, Oxford.
- Hoil G. J. C. M. 2010, El Sistema *Milpero* en el Yucatán Colonial (Siglos XVI-XVIII) Tesis que para optar al grado de Maestro en Historia. Centro de Investigación y Estudios Superiores en Antropología Social. CIESAS. Mérida, México.
- Humphries, S.A. 1989. Modernizing Maya Agriculture: A Case Study of Peasant Entrepreneurship in Northern Yucatán. P.H. Thesis. York University. Ontario.
- INALLI, 2009 Catálogo de las Lenguas Indígenas Nacionales. Variantes Lingüísticas de México con sus autodenominaciones y Referencias Geoestadísticas. SEP México. 371.
- INEGI, 2016 http://www.inegi.org.mx/
- Islebe, G.A. et al. (Eds.). 2015. Biodiversity and Conservation of the Yucatán Peninsula. Springer International Publishing, Switzerland. 401 p.
- Johannessen, C.L., 1982. Domestication Process of Maize Continues in Guatemala. Economic Botany. 36(1):84-99.
- Kense, F.J. editores. Status, Structure and Stratification: Current Arqhaeological Reconstructions. The Archaeological Association of the University of Calgary. U.S.A.
- Kirchhoff, P. 1943. Mesoamérica. Acta Americana. V1.
- Konrad, H.W. 1985. Fallout of the War of the Chacs: The Impact of the Hurricans and Implications for Prehispanic Quintana Roo Process.Thompson, M.; M. T. García
- Landa, Fray D. 1982 (written in 1574-75). Relación de las Cosas de Yucatán. Porrúa. México.
- Levaggy, A., 2001. República de Indias y República de Españoles en los Reinos de Indias. Revista de Estudios Históricos Jurídicos (23) pp. 419-428.
- Levy T., S. Y E. Hernandez X. 1989. Conservación y Aprovechamiento del Recurso Forestal bajo Roza-Tumba-Quema en Yucatán. Seminario Problemática Agrícola y Conservación de Recursos en Yucatán. México.
- Mariaca M. editor. 2012. El Huerto familiar del sureste de México. Secretaría de Recursos Naturales y Protección Ambiental del Estado de Tabasco. El Colegio de la Frontera Sur. México.
- Martín-Castillo M., 2016. Milpa y Capitalismo: Opciones para los Campesinos Mayas Yucatecos Contemporáneos. Limina Estudios Sociales y Humanísticos. XIV. Num. 2. July-December 2016. México. pp. 101-114. ISSN:

1665-8027.

- Matheny, R., Gurr, D., Forsyth, W., and Hauck, F. 1983. Investigations at Edzná Campeche, México. Vol. 1, Part 1: The Hydraulic System, Brigham Young University, Papers of the New World Achaeological Foundation, No. 46, Provo.
- Medina, Un, M. y Quiñones, V., T., 2006. Peregrinando por los Santuarios de la Península de Yucatán. In Estudios de Cultura Maya. XXVII. Centro de Estudios Mayas. D.F. México. 165-180. Available at: http://www.redalyc.org/articulo.oa?id=281322927008
- Méndez G., M.E., 2010. Flora Medicinal. Durán G., R. y Méndez G., M. E. Editores. 2010. P. 349-352. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA. 496 pp. Yucatán
- Montañez E., P., J. Jiménez Osorio, R. Ruenes M., L. M. Calvo, I. Aprovechamientos forestales maderables y no maderables. pp. 360-361. Durán G., R. y Méndez G., M. E. (Eds.) 2010. P. 355. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONABIO, SEDUMA. 496 pp. Yucatán
- Ortiz Y., I., 2001. Comunidad, mulmenyah y Patrimonio Colectivo en Yucatán, Siglo XXI. Mayas.uady.mx/artículo/comunidad.html/. Tomado de Revista Temas Antropológicos. Vol. 23, num. 2, pp 213-232. Fac. de Ciencias Antropológicas de la UADY. Yucatán. México.
- Perales H., R.y Aguirre J., R., 2008. Biodiversidad Humanizada. En Capital Natural de México. Vol. 1. Conocimiento Actual de la Biodiversidad. CONABIO. p. 565-603. México.
- Pérez Ruiz, M.L., 2013 Efraím H. Xolocotzi. Contribuciones al estudio de las familias milperas. Seminario Internacional “Efraím Hernández Xolocotzi” sobre la Milpa Maya. Festival Internacional de la Cultura Maya 2013. Mérida, Yucatán
- Perez T., A. 1981 (1945 1a ed.). La Agricultura Milpera de los Mayas de Yucatán. En Vargas P., L. editor. La Milpa entre los Mayas de Yucatán. Pp. 1-28.
- Pohl, Mary D. 1990. Ancient Maya Wetland Agricultura: Excavations on Albion Island, Northern Belice. Boulder. Westview Press. U.S.A.
- Porter-Bolland, L. et al., 2015. Forest Ecosystems and Conservation. In: Islebe, G.A. et al. Editores. Biodiversity and Conservation of the Yucatán Peninsula. Springer International Publishing, pp 377-394. Switzerland.
- Quezada, 2012. Yucatán Historia Breve. El Colegio de México. Serie Historias Breves. F.C.E. México
- R. Nigh and A. Ford. 2019. El Jardín Forestal Maya: ocho milenios de cultivo sostenible de los bosques tropicales. México: Fray Bartolomé de las Casas. 283 pp.
- Ramírez C., L. A., 2006 Impacto de la globalización en los mayas yucatecos. Estudios de Cultura Maya. Vol.27. pp. 73-97. México. ISSN 0185-2574. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0185-25742006000200004
- Recinos, A. 1990. Popol Vuh, Las antiguas historias del Quiché. F. C. E. 185 p. México.
- Redfield, R. & A. Villa R. 1967 (1a. edición 1934). Chan Kom a Maya Village. The University of Chicago Press. Chicago and London.
- Rodríguez Canto A.; González Moctezuma, P.; Nava Montero, R.; Flores Torres, J., Thuerbeck, N. y González Iturbe, J. A., 2016. Milpas de las comunidades mayas y dinámica de uso del suelo en la Península de Yucatán. Alianza México REDD+ y Centro Regional Universitario Península de Yucatán, de la

Universidad Autónoma de Chapingo. 360 p. Mérida, Yucatán,

- Romero, D. s/f. Evolución de las sequías en la península de Yucatán. México. http://posgrado.aplikart.com/coloquio/assets/david_romero.pdf
- Rosales, M. y Rejón, L. Hacia una aproximación a las unidades de producción del sur de Yucatán. 171-189. www.chapingo.mx/revistas/phpscript/download.php?file=completo&id. Pdf. Universidad Autónoma de Chapingo.
- Rosales G. M. and G. Cervera A. Nuestras Semillas, Nuestras milpas, Nuestros Pueblos Guardianes de las Semillas del Sur de Yucatán, 2020. Secretaría de la Cultura. INAH. Maket Ximbal, Guardianes de las Semillas. 233 p. México.
- Sanabria, O. L., 1986. Etnoflora Yucatanenese: el uso y manejo forestal en la comunidad de Xul, en el sur de Yucatán. Xalapa, Veracruz. Instituto Nacional de Investigaciones sobre Recursos Bióticos. México.
- Santos-Fita, D., 2013. Cacería de Subsistencia, Manejo y Conservación de Fauna Silvestre en Comunidades Rurales de la Península de Yucatán, México. Tesis de Doctorado en Ciencias en Ecología y Desarrollo Sustentable. El Colegio de la Frontera Sur (ECOSUR). 241. Chiapas. México.
- SEDUMA, 2015. PROGRAMA MILPA. Estrategia para el Desarrollo de las Comunidades Mayas en el Estado de Yucatán. SEDUMA (Secretaría de Desarrollo Urbano y Medio Ambiente) – SEDER -Secretaría de Desarrollo Rural – SIIES- Secretaría de Innovación Investigación Educación Superior. November 2015. Yucatán. México.
- SEMARNAT. CONANP. AFD. TNC. 44 p. México.
- Scarborough, V. and Gallopin, G. ,1991. A Water Storage Adaptation in the Maya Lowlands. Science 251: 658–62.
- Siemens, A. and Puleston, D., 1972 Ridged fields and associated features in Southern Campeche: new perspectives on the Lowland Maya, American Antiquity 37: 228–39
- Tec P., J. 1978. El K'ankubul-Ha. Boletín de la Escuela de Ciencias Antropológicas de la Universidad de Yucatán. 32:30-35. Yucatán.
- Teran S. 1989 Los Conucos y el Desarrollo Prehispánico del Puuc. En Revista de la Universidad Autónoma de Yucatán no. 169. 41-55. Yucatán.
- Teran S. Y Ch. Rasmussen. 1992. Estrategia agrícola y religión. Zizumbo, D., CH. Rasmussen L. Arias Y S. Teran, Editores. La Modernización de la Milpa: Utopía o Realidad. CICY-DANIDA, 227-245. Yucatán.
- Teran S., Rasmussen, Ch. y May C., Olivio, 1998. Las Plantas de la Milpa entre los Mayas. Fundación Tun Ben Kin A.C. 278 p. Yucatán.
- Terán, S.; Rasmussen, C., 2009. La milpa de los mayas: La agricultura de los mayas prehispánicos y actuales en el noroeste de Yucatán. Universidad Nacional Autónoma de México y Universidad de Oriente. Mérida, 396 p. Yucatán.
- Teran S. y Ch. Rasmussen. 2008. Jinetes del Cielo Maya. Dioses y Diosas de la Lluvia. Universidad Autónoma de Yucatán (UADY). 388 p. Yucatán.
- Turner, Billie. L. II, 1979 Prehispanic Terracing in the Central Maya Lowlands: Problems of Agricultural Intensification, Mesoamerican Archaeology and Ethnology, Norman Hammond y Gordon R. Wiley (eds.). Austin: University of Texas Press, 103-113.
- Turner, Billie, L. II 1983 Once Beneath the Forest: Prehistoric Terracing in the Rio Bec Region the Maya Lowlands. Boulder: Westview Press.

- U Yits ka'an. Escuela de Agricultura Ecológica. 2016.Tsool K'iin 2016. Cargador del año 4 caban. La Cuenta de los días. Maní, Yucatán: s/e.
- Várguez P., L.A., editor. 1981. La Milpa entre los Mayas de Yucatán. Departamento de Estudios sobre Cultura Regional. UDY. Mérida.
- Vassallo R., M. M., 2008. Mats': La fuerza que corre por nuestras venas El uso del pozol, una bebida de maíz, en algunas comunidades del área maya. Un estudio diacrónico. Tesis de Licenciatura en Etnohistoria. Escuela Nacional de Antropología e Historia (ENAH). 523 pp.México.
- Vavilov, N.I., 1949. The Origin, Variation, Inmunity and Breeding of Cultivated Plants. Vol. 13, Chronica Botánica. Waltham Mass. USA.
- Villanueva M., E. 1990. La Formación de las Regiones en la Agricultura (El Caso de Yucatán). Maldonado/INI/FCA-UADY/ CEDRAC. Yucatán
- Villers R., L., R.M. Lopez Franco Y A. Barrera M. 1981. La Unidad Habitación Tradicional Campesina y el manejo de Recursos Bióticos en el Área Maya Yucatanense. Biótica. 6/3:293-323. México.
- Wolf, E. 1979 Pueblos y culturas de Mesoamérica, Ediciones Era. México.
- Zaldívar J. M.A., J. A. Herrera S., C. Teutli H., F. A. Comín, J. L. Andrade, C. Coronado M. y R, Pérez C., 2010. Conceptual Framework for Mangrove Restoration in the Yucatán Península. Ecological Restoration. September 1. Vol. 28 No. 3, pp. 333-342.
- Zapata, R., 2010. En Durán R. y M. Méndez eds. Biodiversidad y Desarrollo Humano en Yucatán. CICY, PPD-FMAM, CONACyT, SEDUMA. 496 pp. Yucatán.
- Zizumbo, V., D.1986. El Manejo de Alta Diversidad en Plantas Cultivadas: Estrategia Central de la Agricultura Mesoamericana. Boletín de la Escuela de Ciencias Antropológicas de la Universidad Autónoma de Yucatán. 81:3-15. Yucatán.
- Zizumbo, V., Chr. Rasmussen, L.M. Arias y S. Terán (editores). 1992. La modernización de la milpa en Yucatán: Utopía o realidad. Centro de Investigación Científica de Yucatán. Danida. Mérida. México.
- Zizumbo-Villarreal, D. y Colunga García Marín, P., 2008. El origen de la agricultura, la domesticación de plantas y el establecimiento de corredores biológicos culturales en Mesoamérica en Geografía Agrícola. No. 41.Dic. 01-33. México.
- Zizumbo- Villarreal, D., Flores-Silva, A., y Colunga García-Marín, P. 2012.The Archaic Diet in Mesoamerica: Incentive for Milpa Development and Species Domestication. Economic Botany. XX(X). 1-16. Published online: 24 October 2012.
- Zizumbo Villarreal, D., Colunga García-Marín, P., May Pat, F., Martínez Castillo, J. y Mijangos Cortés, J. 2010. Recursos fitogenéticos para la alimentación y la agricultura. En R. Durán García y M. E. Méndez González Editores, Biodiversidad y desarrollo humano en Yucatán 334-339. Mérida: CICY, PPD-FMAM, CONABIO, SEDUMA. Yucatán.
- Zorrilla y otros. 1982. El Maíz, Museo de Culturas Populares. SEP. México

- **Other sources for consultation and photographic complements**

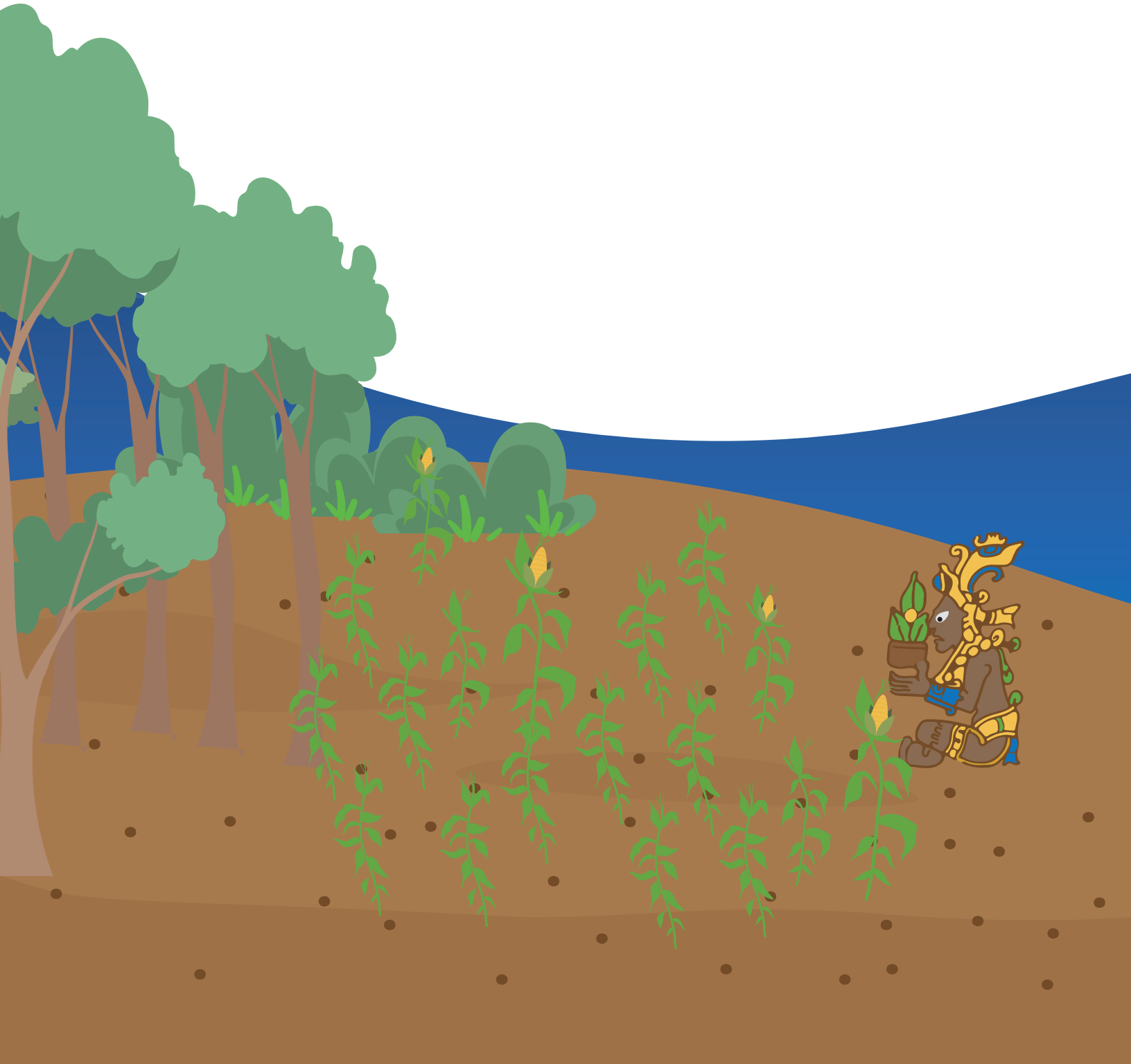
- Page 57 Left (Representation of first contacnt from the Conquista) Illustration: https://www.timetoast.com retrived 2022
- Page. 57 Right (Henequén Factory) Photo: https://www.mindomo.com retrived 2022
- Page. 69 (Hacienda henequenera) Photo:

https://www.istockphoto.com/ retrived 2022

- Page. 70 (Caste Wars) Photo: https://lectambulos.com/ retrived 2022
- Page. 84 (The tradicional kanché) Photo: https://journals.openedition.org/elohi/1154 retrived 2022
- Page. 140 (Young Mestizas wearing a terno) Photo: https://es.123rf.com retrived 2022
- Page. 140 (A group of “cowgirls” dancing) Photo: https://yucatantoday.com/ retrived 2022
- Page 140 (Gremio or union of ladies in Ticul) Photo: https://yucatantoday.com/ retrived 2022
- Page. 141 down (Preparation of tamales for The Food of the Dead) Photo: https://www.mexicodesconocido.com.mx/ retrived 2022
- Page 141 (Altar with offerings for children) Photo: https://www.mexicodesconocido.com.mx/ retrived 2022
- Page. 142 (Jeetz Mek godfather carries the child while the godmother brings a machete for the baby to learn how to knock down trees and make milpa) Photo: https://www.milenio.com/ retrived 2022
- Page143 (Santa Cruz. Patron saint of the Maya village of Xocen…) Photo: https://www.ranchocampestrepalchahal.com/ retrived 2022
- Page. 143 (Altar with offerings for children) Photo: https://www.mexicodesconocido.com.mx/ retrived 2022
- Page. 144 (A Ch’a’acháak ceremony. Xocen, Valladolid, Yucatan)Photo: https://www.yucatan.com.mx/ retrived 2022
- Page. 145 (Representation of the Melipona beecheii or xunaan kab in the Madrid Codex) Photo: https://www.revista.unam.mx/ retrived 2022
- Page. 151 (J’men or Maya priest making a loj to help cure a sick young man) Photo: https://alltournative.com.mx/ retrived 2022
- Page159 (Mangrove) Photo: https://sds.yucatan.gob.mx/ retrived 2022
- Page. 162 (Aereal view of petenes) Photo: https://escapadas.mexicodesconocido.com.mx/ retrived 2022
- Page. 166 (Rejolladas in Yucatan) Photo: https://www.asociaciontikal.com/ retrived 2022
- Page. 167 (Drains X’uuch) Photo: https://yucatantoday.com/ retrived 2022
- Page. 168 (A woman standing next to a sartaneja) Photo: https://yucatantoday.com/ retrived 2022
- Page. 168 (Dried out pools, sartenejas, or jaltunes) Photo: https://yucatantoday.com/ retrived 2022
- Page. 173 (Aerial photo of Merida with urban orchards) Photo: https://congresomujerespoliticas.mx/ retrived 2022
- Page. 174 (Convent of Maní, Yucatán…) Photo: https://larevistadelsureste.com/ retrived 2022
- Page 244 (Milperos during seed dispersal process) Photo: http://www.yucatan.gob.mx/ retrived 2022

PHOTO:MARIGEL CAMPOS CAPETILLO

ANNEXES



Annex 1

Native species and variants in the 16th century Mayan milpa system and the current milpa.[1]

Scientific name (family, species, and variety)		Current Maya name (With variants)	Current Spanish name	Cicle	
	1	***ARACEAE***		C	L
1 ***XANTHOSOMA YUCATANENSE. ENGLER (S.E.A.) (A.D.A)***[1]	1	***KUKU MAKAL***	***ÑAME***		
	1	***XMEJEN MAKAL***			
	2	***MAI MULA***	***ÑAME CHICO***	x	
	3	***XMEJEN SAC***		x	
		MAKAL			
		XNUK MAKAL	***ÑAME GRANDE***		x
	4	***XKABEEN***	***ÑAME ROSADO***		
	1	***CARICACEAE***		C	L
2 ***CARICA PAPAYA L.***	2	***PUUT***	***PAPAYA***		
	5	***XK'AN PUUT***			
	6	Chak Mamey			
	3	CONVULVULAVEAE		C	L
3 *Ipomoea batatas (L.)* **lam**	3	Is			
		Xmejen Is[2]			
	7	Xcubana	Camote	x	
		Xnuk Is	Camote chico		
	8	Chkalhaas Is			x
	9	Xrosado Is	Camote grande		x
	10	Sak Is			x
	11	K'an Is			x
	12	Morado Is			x

1 The identification of the species is based on Sosa et al. and Álvarez, when in the latter the identification does not appear, or coincides with the Sosa et al. we use the first selection, but we have no inclination for one.

1 Source: Terán, S.; Rasmussen, C. (2009). La milpa de los mayas: La agricultura de los mayas prehispánicos y actuales en el noroeste de Yucatán. Universidad Nacional Autónoma de México y Universidad de Oriente. Mérida, Yucatán. 396 pág.

2 Toop' and Sikil have different names for the seed and the fruit, while Dzol at, has only one name for the fruit. However, Toop' and Sikil are named primarily by the name of their seed, but not by the name of the fruit.

Scientific name (family, species, and variety)		Current Maya name (With variants)	Current Spanish name	Cicle	
	4	CUCURBITACEAE[1]		C	L
4 *Cucurbita argyrospema* **Huber (S.e.a) (Sin: C. Mixta. Pang)**	4	Xtoop' o Xka'[2]	Pepita gruesa o Xka (Fruto)		
	13	Sak Xka'			
	14	K'an Xka'			
5 *C. moschata* **(Duch) / Duch Ex. Poir**	5	Sikil o K'uum	Pepita		
		Xmejen K'uum	menuda o Calabaza		
	15	Xtobox	Calabaza chica		x
	16	Is K'uum			x
	17	X'Kalim			x
		Xnuk K'uum	Calabaza grande		
	18	Xtobox Nuk			x
		K'uum			x
	19	Is Nuk K'uum			
	20	Xkalim Nuk			x
		K'uum			x
	21	Cahi K'uum ó Kay Pats			
	22	Sak Xnuk K'uum			x
	23	Chuji Xnuk K'uum			x
	24	Ara Xnuk K'uum			x
	25	Xkakau Nuk K'uum			x
6 *C. Pepo L.* **(S.e.a)**	6	Ts'ol[4]	Tsol		
	26	Tsol Redonda			
	27	Xkakao Ts'ol			

1 It is an introduced variant
2 Toop' and Sikil have different names for the seed and the fruit, while Dzol at, has only one name for the fruit. However, Toop' and Sikil are named primarily by the name of their seed, but not by the name of the fruit.

Scientific name (family, species, and variety)		Current Maya name (With variants)	Current Spanish name	Cicle	
7 *Lagenaria siceraria* **(Molina) Standley**	28	Sak Cluj	Calabazos		
	29	Yaax Cluj	Calabazo		
	30	Lek	Lec		
	5	**EUPHORBIACEAE**		C	L
8 *Cnidoscolus chayamansa* **Mc Vaugh (S.e.a) (A.j.a)**	8	Chay	Chaya		
	9	Ts'iim	Yuca		
	31	Xmejen	Yuca chica		
		Ts' lim			
9 *Manihot esculenta* **Crantz**		Ak' Its'iim			
	32	K'an Ts'iim		X	
	33	Sak Ts'iim		X	
		Knut Ts'iim	Yuca grande		
	34	Yaax Ts'iim			X
		Obox Ts'iim			
	6	**GRAMINEAE**		C	L
10 *Zea mays L.*	10	Nal o Xi'im	Maíz/Mazorca grano		
		Xmejen Nal	Maíz chico		
	35	Sak Nal T'el		X	
	36	K'an Nal T'el		X	
	37	Xtojip		X	
	38	Sak Xt'uup		X	
	40	Chaksel o Chaknal		X	X
	41	Ek' Chob		X	
		Xnuk Nal	Maíz grande	X	
	42	Xnuk Sak Nal			X
	43	Box Joloch			X

Scientific name (family, species, and variety)		Current Maya name (With variants)	Current Spanish name	Cicle	
	6	LEGUMINOSAE		C	L
11 *Pachyrhizus erosus* **(L.) Urban**	11	Chiikam	Jícama		
12 *Pachyrhizus erosus* **(L.)**	45	Sak Chiikam			
	46	K'an Chiika			
13 *P. Vulgaris L.* **(S.e.a.)**	12	Ib	Ib		
		Xmejen Ib	Ib Chico		
	47	Xobxd		X	
		Xmejen Ib			
	48	Sak Mejen Ib		X	
	49	Chak Saak			
		Xmejen			
		Ib		X	
		Xnuk Ib	Ib Grande		
	50	Xnuk Sak Ib			X
	51	Xnuk box Ib			X
	52	Xnuk Chak Saa			
	53	Xk'an Obat o Xbatun			X
	54	Xpix Cristo			X
	55	Xpuksik'a			
		Ts' uts'uy			
	56	Bacalar Ib			
	57	Xmulicion			
	58	Jol Xpet			X
	13	Xkoli Bu'ul			X
			Frijol de la milpa		
	59	Box Bu'u	Frijol Sama'		
	60	E'subin Bu'ul			
	61	Tsama Bu'ul			

Scientific name (family, species, and variety)		Current Maya name (With variants)	Current Spanish name	Cicle	
	8	**PALMEAE**		C	L
14 *Sabal spp.* **(A.s.j)**	14	Xaan	Huano		
	63				
	9	**SOLANACEAE**		C	L
15 *Capsicum annum* **L.**	15	Ik	Chile		
	64	Yaax Ik Chawa' Ik			
	65	Dulce Ik[3]			
16 *Lycopersium esculentum* **L.**	16	P'ak			
	66	Macehual ó País p'ak			
	67	Tsum P'ak			
9 **FAMILIES AND** 16 **NATIVE SPECIES**	16 67	**SPECIES VARIANTS**		19	24

Annex 2

Plants grown in milpa (inter-cropped associates).[1]

Scientific name (Family, species, and variety)	Maya name	Common name in Spanish		Cicle		
		Crop	Variant		C	L
GRAMINEAE *Zea mays L.*	**1 NAL**	**Maíz**				
	1.1 XMEJEN NAL	Maíz Chico				
	SAK NAL T'EL		Maíz "gallo" blanco		x	
	KA'N NAL TE'L		Maíz "gallo" amarillo		x	
	XTOJIP		Maíz negro		x	
	SAK XT'UUP		Maíz chico blanco		x	
	K'AN XT'UUP		Maíz chico amarillo		x	
	CHAKSEL O CHAK NAL		Maíz rojo		x	
	EK' CHOB		Maíz negro			
	1.2 XNUK NAL					
	XNUK SAK NAL		Maíz grande blanco			x
	BOX JOLOCH		"Cáscara negra"			x
	XNUK K'AN NAL		Maíz amarillo grande			x
CUCURBITACEA *C. moschata* (DUCH) DUCH ex Poir	**2 K'UUM O SIKIL**	**Calabaza o Pepita Menuda**				
	2.1 XMEJEN K'UUM	Calabaza chica				
	XTOBOX		Cáscara gruesa	x		
	IS K'UUM		Calabaza "camote" de cáscara delgada	x		
	X'KALIM		Cáscara granulada	x		

1 Source: Terán, S.; Rasmussen, C. (2009). La milpa de los mayas: La agricultura de los mayas prehispánicos y actuales en el noreste de Yucatán. Universidad Nacional Autónoma de México y Universidad de Oriente. Mérida, Yucatán. 396 pp.

Scientific name (Family, species, and variety)	Maya name	Common name in Spanish		Cicle		
		Crop	Variant		C	L
	2.2 XNUK K'UUM	Calabaza grande				
	XTOBOX XNUK K'UUM		Calabaza grande de cáscara gruesa			x
	IS XNUK K'UUM		Calabaza "camote" de cáscara gruesa			x
	XCALIM NUK K'UUM		Calabaza grande de cáscara granulada			x
	CHAI K'UUM O KAY PATS		Calabaza de franjas verdes como chaya			x
	SAK XNUK K'UUM		Calabaza grande blanca			x
	CHUJ XNUK K'UUM		Calabaza grande en forma de calabazo			x
	ARA XNUK K'UUM		Calabaza grande en forma de plato			x
	XKAKAU NUK K'UUM		Calabaza grande en forma de cacao			x
LEGUMINOSAE *Phaeseolus vulgaris* L.	**3 XKOLI BU'UL**	**Frijol de la milpa**				
	BOX BU'UL		Frijol negro			
	E' SUBIN BU'UL		Frijol			
CUCURBITACEAE CUCURBITAE *Argyrosperma* HUBER (Sin: C. Mixta Pang)	**4 XKOLI BU'UL**	**Ka O pepita gruesa**				
	SAK XKA'		Ka blanca (redonda)			
	K'AN XKA'		Ka amarilla (ovalada)			
LEGUMINOSAE *Phaseolus lunatus* L.	**5 IB**	**Ib**				
	5.1 XMEJEN IB	Ib chico				
	X BOS MEJEN IB		Ib chico negro	x		
	SAK MEJEN IB		Ib chico blanco	x		
	CHAKSAAK XMEJEN IB		Color de patita de langosta de monte	x		

Scientific name (Family, species, and variety)	Maya name	Common name in Spanish		Cicle		
		Crop	Variant		C	L
	5.2 XNUK IB	Ib grande				
	XNUK SAK IB		Ib blanco grande			x
	IXNUK SAK IB		Ib negro grande			x
	XXNUK BOX IB		Color de patita de langosta de monte grande			x
	XK'AN OBAT O XBATUN		Ib grande marillo			x
	XPIX CRISTO		Ib pinto negro y blanco			x
	XPUKSIK'A TS'UTS'UY		Ib redondo rojo quemado "corazón de palomita salvaje"			x
	BACALAR IB		Ib amarillo pinto cuadrado			x
	XMULICION		Blanco			x
	JOL XPET					
LEGUMINOSAE *Vigna unguiculata* L.	6 XPEERON	**Espelón**				
	6.1 XMEJEN PEERON	Espelón chico				
	XBURIOS(GUA) TSUK PEERON		Espelón burios			
	BOX TSUC PEERON		Espelón tsuk negro			
	SAK TSUC PEERON		Espelón tsuk blanco			
	6.2 XNUC PEERON	Espelón grande				
	BOX PEERON O YAAX PEERON		Espelón negro o verde			x
	SAK PEERON O XIIPEERON		Espelón blanco			x
Cajanus cajan **(L.) Millsp.**	7 XRENTEJA	**Lenteja**				
	K'AN XRENTEJA		Lenteja amarilla			x
	TABASQUEA		Tabasqueña			x
	TSITSIBA		Tsitsiba			x

Scientific name (Family, species, and variety)	Maya name	Common name in Spanish		Cicle		
		Crop	Variant		C	L
LEGUMINOSAE *Phaseolus vulgaris* L.	8 **TSAMA BU´UL**	**Frijol Sama**				
CUCURBITACEA *Lugenaria sicereria* (MOLINA) Standley	9 **CHUJ**	**Calabazo**				
	SAK CHUJ		Calabazo blanco			
	YAAX CHUJ		Calabazo negro			
CUCURBITACEA *Lugenaria sicereria* (MOLINA) Standley	10 **LEK**	**Lek**			x	
PALMAE *Sabal ssp.*	11 **XAAN**	**Huano**				
AMARANTHACEA *Celosia argentea* L. var. Cristata (L) voss	12 **XTEES**	**Tess**				
CONVULVACEA *Ipomoea batatas* (L) Lam.	13 **IS**	**Camote**				
	13.1 **XNUC PEERON**	Camote chico				
	XCUBANA		Camote cubano		x	
	13.2 **XNUC PEERON**	Camote grande				
	CHAKALHAAS IS		Camote mamey			x
	XROSADO IS		Camote rosado			x
	SAK IS		Camote blanco			x
	K`AN IS		Camote amarillo			x
	MORADO IS		Camote morado			x
ARACEA	14 **KUKUT MAKAL**	**Ñame**				
Xantoshoma yucatanense Engler	14.1 **XMEJEN MAKAL**	Ñame chico				
	MAI MULA		Pata de mula		x	
	XMEJEN SAK MAKAL		Ñame blanco chico		x	
	14.2 **XNUK MAKAL**	Ñame grande				
	XKABABEN		Ñame rosado			x

Scientific name (Family, species, and variety)	Maya name	Common name in Spanish		Cicle		
		Crop	Variant		C	L
DIOSCOREACEAE *Diosorea alata* L.	15 **AK' IL MAKAL**	**Makal bejuco**				
	SAK AK'I MAKAL		Makal de bejuco blanco			
	MORADO		Makal morado			
EUPHORBIACEA *Manihot esculenta* Crantz	16 **TS'IIM**	**Yuca**				
	16.1 **XMEJEN TS'IIM**	Yuca chica				
	AK'I TS'IIM					
	KA'N TS'IIM		Yuca amarilla		x	
	SAKTS'IIM		Yuca blanca		x	
	16.2 **XNUK S'IIM**	Yuca grande				
	YAAX TS'IIM o BOX TS'IIM		Yuca verde o negra			x
LEGUMINOSAE *Pachyrrzhus erosus* (L.) Urban	17 **CHIIKAM**	**Jicama**				
	SAAK HIKAM		Jicama blanca			
	K'AN CHIIKAM		Jicama amarilla			
MARANTACEA *Maranta arundinacea L.*	18 **CHAAK**	**Sagú**				
DIOSCOREACEAE *Dioscorea bulbifera L.*	19 **XVOLADOR**	**Volador**				
CUCURBITACEA *C. pepo L.*	20 **TS'OL**	**Tsol**				
	TSOL REDONDA					
	XKAKAO TS'OL		Tsol forma de cacao	x		
SOLANACEAE *Lycopersicum esculentum* L.	21 **P'AK**	**Tomate**				
	MACEHUALO PAIS P'AK		Tomate indio o pais	x		
	TSUM P'AK		Tomate tsum	x		
	XJOBON		Tomate jobon	x		

Scientific name (Family, species, and variety)	Maya name	Common name in Spanish		Cicle		
		Crop	Variant		C	L
CUCURBITACEAE *Citrullus lanatus* (Thum.) Matsumara & Nacai	22 **SANDIA**	**Sandía**				
	KASNTRAN		Kastran chica roja dulce	x		
	YAAX		Verde grande	x		
	SAK		Blanca grande	x		
	WEWEL		Grande cáscara Gruesa, medio roja, medio blanca			
CUCURBITACEA *Cucumis melo* L.	23 **MELON**	**Melón**				
	YAAX		Verde			
	K'AN CHIIKAM		Amarillo			
CUCURBITACEAE *Cucumis sativus* L.	24 **PEPINO**	**Pepino**	Yuca blanca			
	YAAX	Yuca grande	Verde			
	SAK		Blanco			
SOLONACEAE *Capsicum Nahum* L.	25 **IK**	**Chile**				
	YAAX IK O CHAAW IK		Chile verde o chaw			
	DULCE IK		Chile dulce			
ALILIACEAE *Allium cepa* L.	26 **CEBOLLA**	**Cebolla**				
Allum ssp.	27 **CEBOLLIN**	**Cebollín**				
PEDIALACEAE *Sesamum indicum* L.	28 **SIKLP'UUS**	**Ajonjolí**				
MUSACEAE *Musa paradisiaca* L.	29 **HAAS**	**Plátano**				
	CHAK HAAS		Plátano rojo			
	XKURI HAAS		Plátano kuri			
	XMACHO HAAS		Plátano macho			
	XBARBARO HAAS		Plátano bárbaro			
	XK'AN MANZANO HAAS		Plátano manzano amarillo			
	YAAX MANZANO HAAS		Plátano manzano verde			

Scientific name (Family, species, and variety)	Maya name	Common name in Spanish		Cicle		
		Crop	Variant		C	L
EUPHORBIACEAE *Cnidosculus chayamansa* Mc Vaugh	30 **CHAYA**	**Chaya**				
CARICACEAE *Carica papaya* L.	31 **PUUT**	**Papaya**				
	XK'AN PUUT		Papaya amarilla			
	CHAK MAMEY PUUT		Papaya mamey rojo			
	32 **XWAH BU'UL**	**Frijol Huach**				
Total 32 species with 95 variants						

Annex 3

Mammals hunted in the Maya milpa zone[1]

Common name	Name in Maya	Scientific name
Gopher	Ba’	*Orthogemys hispidus*
Agouti	Tsu’ub	*Dasyprocta punctata*
Paca	Jaleb	*Agouiti paca*
Coati	Chi’ik ch’we	*Nasua narica*
Armadillo	Uech	*Dasypus novemcintcus*
White lipped peccary	Kitam	*Tayassu pecari*
Collared peccary	Kitam	*Pecari tajacu*
Red deer	Yuk	*Mazama americana*
White-tail deer	Ceh	*Odocoileus virginianus yucatanensis*
Ant eater	Chab	*Tamandua mexicana*
Margay	Sak xikin	*Felis wieddi*
Ocelot	Chak mo’ol	*Felis pardalis*
Raccoon	K’ulu’	*Procyon loto*
Jaguar	Balam	*Pantera onca*
Kinkajou	Ma’ax	*Potos flavus*
Porcupine	Kix pay ox	*Coendu mexicanus*
Howler monkey		*Alouatta pigra*
Spider monkey	Ma’ach	*Ateles geoffroyi*
Tapir	Tsimin	*Tapirus bairdii*
Squirrel	Ku’uk	*Sciurus deppei*
Puma	Coh	*Puma concolor*
Jaguarundi	Emuch	*Herpailurus yagouaroundi*
Opossum	Och	*Didelfis marsupialis*
Tayra	San hool	*Eyra barbara*

1 Source: CRUPY Report (Rodríguez, A. et. Al., 2016 pp. 172-173). Adapted from Ramírez and Naranjo (2007) and Uc (2014)

Annex 4

Birds hunted in the Maya milpa zone[1]

Common name	Name in Maya	Scientific name
Partridge	Noom	*Cypturellus cinnamomeus*
Chachalaca	Ixbach, baach	*Ortalis vetula*
Ocellated turkey	Kuuts	*Agriocharis ocellata*
Yucatecan quail	Beech	*Colinus nigrogularis*
Spotted quail	Beech	*Odontophorus guttatus*
Curassow	Kambul	*Crax rubra*
Wild duck		*Cairina moschata*
Tucan		*Ramphastos sulfuratus*
Partridge		*Odontophorus guttatus*
Doves		*Various types*
Parrot		*Amazona albifrons*
Yucatan Parrot		*Amazona xantholora*
Tinamou		*Crypturellus cinnamomeus*
Tucanet		*Pteroglosus torcuatus*
Cardinal		*Cardenalis cardenales*
Canary		*Cyanocompsa parellina*

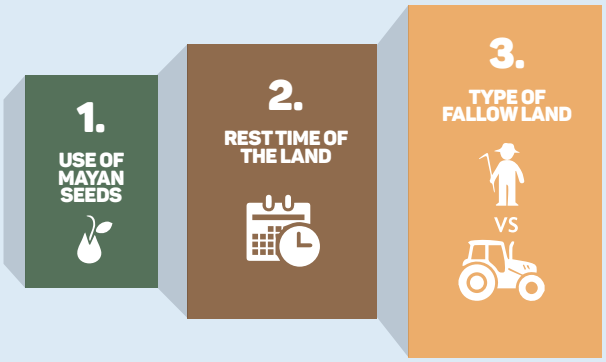
1 Source: CRUPY Report (Rodríguez, A. et. Al., 2016 pp. 173-174). Adapted from Ramírez and Naranjo (2007) and Uc (2014)

Annex 5[1]

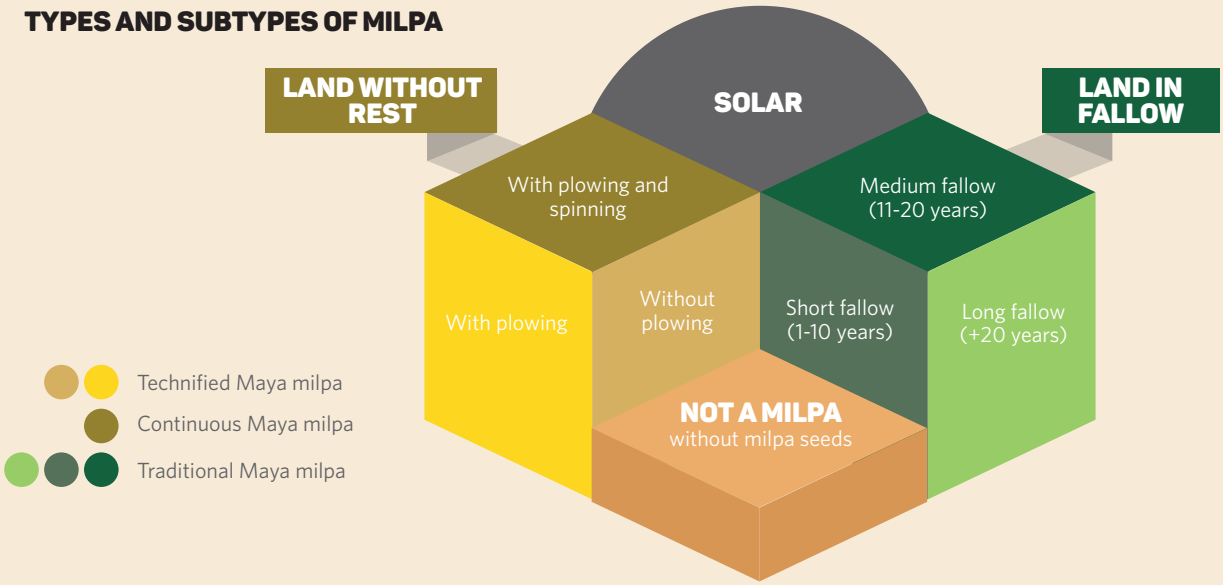
WHAT IS THE MILPA?

The Yucatan Peninsula has more than 2,000 agricultural production units and 79% of them produce milpa.

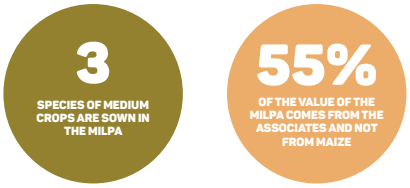
The study of Maya milpas proposes three types of milpas based on three criteria



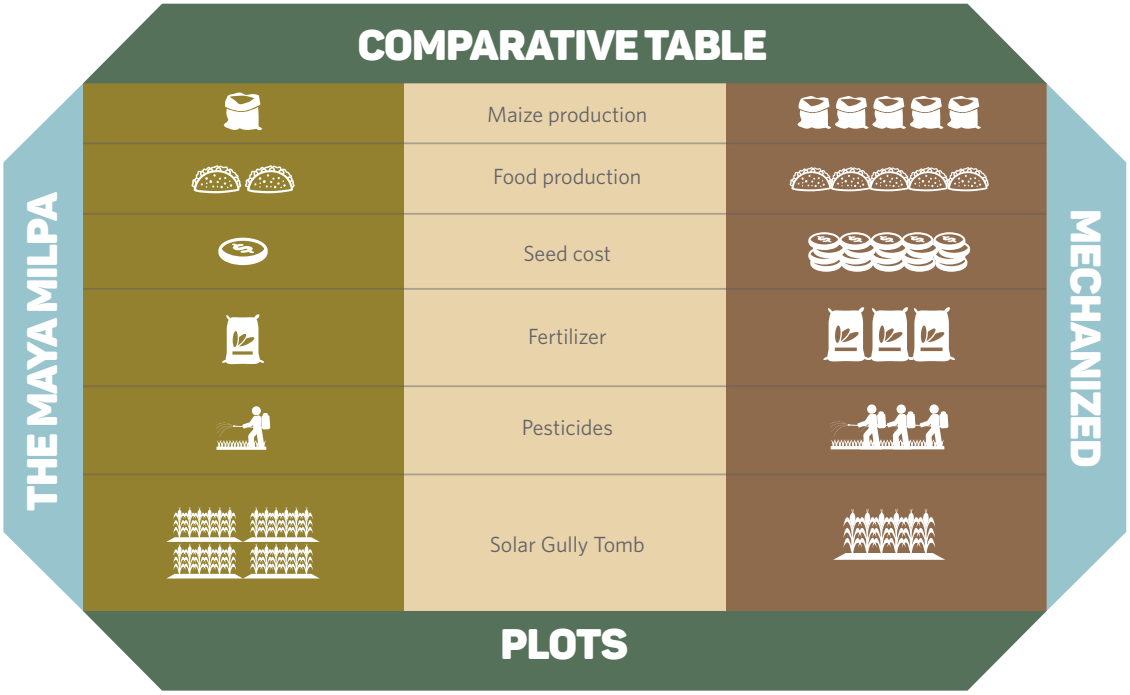
TYPES AND SUBTYPES OF MILPA



THE MILPA IS NOT ONLY MAIZE, THERE ARE MORE SPECIES, NEVERTHELESS MAIZE IS VERY IMPORTANT

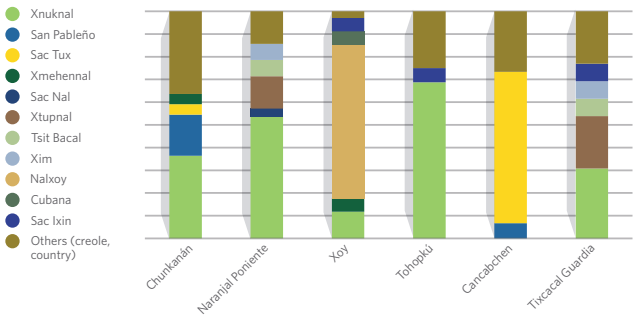


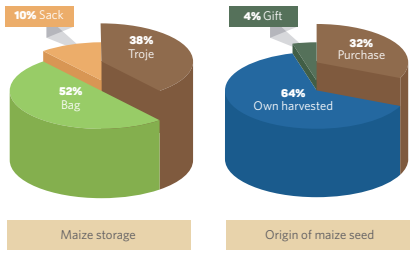
1 CRUPY report (Rodriguez, A. et. Al., 2016 p. 36)



86%

OF MILPEROS SOWN NATIVE MAIZE IN 2012. DIFFERENT VARIETIES OF MAIZE ARE PLANTED IN EACH COMMUNITY





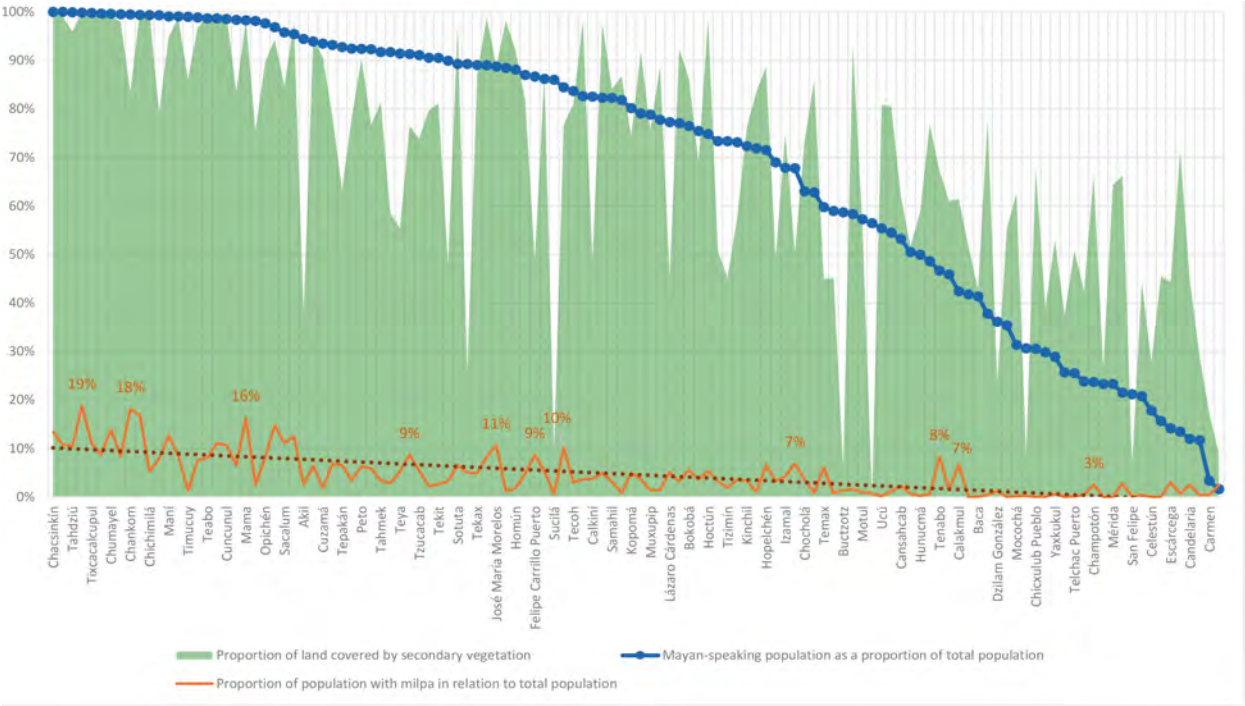
Source: survey in six communities in the Yucatan Peninsula.

Annex 6

Relationship between the proportions of secondary vegetation coverage, Maya-speaking population and population dedicated to the milpa by municipalities of the Yucatan Peninsula

The correlation between secondary vegetation, milpa and Mayan population reflects an important interdependence between the three.

The fact that the forest has disappeared where other land uses such as cattle ranching and commercial agriculture have expanded and that the forest exists where milpa is practiced under slash-and-burn vegetation, indicates that this is the best technology to manage this forest.



CRUPY Report (Rodríguez, A. et. al., 2016 p. 36).

Annex 7

Rain Gods with Maya name, translation, attributes, and direction from which they come from

Name	Translation	Attributes	Direction
Ki'ichkelen Taata Yum +			
Sak Papa'atun Ch'áak	Papa'atun white rain god	Brings the best rains	Southeast
Ch'áak Papa'atun Ch'áak	Papa'atun red rain god	Not very good rains	Southwest
Kan Papa'atun Ch'áak	Papa'atun yellow rain god	Not very good rains	Northeast
Ee' Papa'atun Ch'áak	Papa'atun black rain god	Good rains with good weather	Northwest
Ye'ebatun Ch'áak or Yiiba'an Ka'an Ch'áak or Yiiba'atun Ch'áak	God-dew-Batun-rain	Rain, but not very heavy rain	Southeast
Aj Bolon Ch'áak or Aj Bolon Ka'an Ch'áak or Bojol Ka'an Ch'áak	Male god-nine rains or male god-nine sky-rain or God with pumpkin helmet –sky-rain	There is only thunder, but no rain. The wind blows. The clouds they form are small. These gods are tricky because it is not the time for rain.	Northwest
Ts'iba'an Ka'an Ch'áak	God-writing-sky-rain	It only produces shade. The shadow helps the milpa	East
Aj P'iikit iikit Ka'an Ch'áak	Male-god-jump-rain	It only produces wind and lightning, but it helps the plants.	Northwest
T'olot Ka'an Ch'áak	?	It makes clouds 1 km wide. It rains.	Southwest
Aj Kulut Ka'an Tun Ch'áak	Male-God-Set-Sky-Stone-Rain-Clouds	It rains in the afternoon	East
Sisal Ka'an Ch'áak o Sise'en Ka'an Ch'áak o Siis Há Ch'áak	God-coolness-sky-rain	Drizzles that cool the earth before the rein	Southwest
Sutut Ka'an Ch'áak o Suput Ka'an Ch'áak	?	Rain that comes from all four sides	East
Tsolon Ka'an Ch'áak	God-Line-Sky-Rain	Many "cheques" make a line	
T'upul Ka'an Ch'áak o Tup'ul Ka'an Ch'áak	God-the smallest-sky-rain or God-explode-Sound-Rain	Brings the very best rains	Southeast
Kalan Papa'atun Ch'áak	?	Husband of the Ch'áak caregiver	

Annex 8

Rain Goddess (Clouds) Maya name, translation, attributes and direction from which they come from

Name	Translation	Attributes	Direction
X'k'anle' oox munial	Goddess-yellow-leaf-three-cloud Companion of god 1	Works with Sak Papa'atun Cha'áak. Is managed by Muxuun Kaab.	Southeast
Chak Papa'atun Cháak	Goddess-red- Papa'atun-rain Companion of god 2	Not very good rains	Southwest
X'oóxle' Munial	Goddess-three-leaf-clouds Companion of God 3	Companion of K'an Papa'atun Yellow rain	Northwest
Ooxlajun taan Eele' Munial	Thirteen-in-front-Black-leaf-cloud Wife of God 4	Bad yellow rain	Southeast
Tsoloot Ka'an Soolot Ka'an Ch'áak	Companion of god 5	Big cloud that looks like rain that floats up and is dispersed, but does not rain	Southeast
Tsoloon or Tsolon Ka'an Ch'áak	Companion of god 6		Northeast
a) Yiiban Ka'an Ch'áak or b) X'yiiba'atun Ka'an Ch'áak or c) Ts'iba'an Ka'an Ch'áak	Goddess-melted-sky-rain Wife of god 7	Scribe for Sh'áak. Takes notes of the offerings Only provides shade, but this helps plants	East
Aj P'iikit Ka'an Ch'áak	Wife of god 8	Only makes wind and lightning but it helps plants	Northwest
T'olot Ka'an Ch'áak or Toolot Ka'an Ch'áak	Wife of god 9	Forms clouds about 1 km wide	Southwest
Aj Kulut Ka'an Tun Ch'áak	Wife of god 10	Still clouds and rain in the afternoon	East
Sisal Ka'an Ch'áak or Yi'iba'tun Ch'áak (Rel. 1)	Wife of god 11	Drizzle cooling the east prior to rain	Southwest
Sutut Ka'an Ch'áak Kanti'is K'uj	Wife of god 12	Rain coming from all four sides	East
Nitil Ka'an Ch'áak	Wife of god 13	Many "chaques" make a line	

Name	Translation	Attributes	Direction
Sak X'tup'uk Ka'an Ch'áak ó Tupul Ka'an Ch'áak ó Sak X't'upul Ka'an Ch'áak	Goddess-white-sound-sky-rain / goddess-put out fire-sky-rain or goddess-white-the youngest-rain Companion of god 14	Forms a ceiling of white clouds. Good rain. The biggest rain	Southeast
Kalan Oxlajun Munial	Goddess-guardian-thirteen-clouds Wife of god 15	Keeps the greatest fountain of celestial water. Keeps the waves, opens the faucet. Makes the cloud grow for rain.	Northwest

* Because all goddesses carry the appellation X'Ko'olebil, it has been omitted to avoid repetition in each box.

Annex 9

The Xok K'iin , the counting of days, or folk weather prediction[1].

The ancient Maya amassed an impressive body of astronomical knowledge, including several calendars. The most important were: 1) the *Xok K'iin* , a sacred calendar comprised of 260 days ("kin") divided into 20 months, each of which had 13 days; 2) the *haab* solar calendar, of 365 days in total, comprised of 18 months of 20 days, plus 5 additional days (called "uayeb"). These were the major time references for when to perform agricultural practices and ceremonies, among other things.

The use of the 12-month Gregorian calendar was imposed with the arrival of the Spanish and, with cultural impositions, it was assimilated and reused. For the Maya, this meant dating the events of daily life, largely constituted by agricultural activities.

Today, the *xok k'iin* (counting of days) takes place in January and is based on the Gregorian calendar. This counting of days also considers the agricultural and ceremonial calendar, which refers to agriculture and ceremonies that date back to the time of ancient Maya (*U Yits ka'an*, School of Ecological Agriculture, 2016).

Erratic rainfall patterns and the need to have some certainty of when the next rain would be, may have been the factor that led to the search for and identification of certain early phenomena that correlated with annual climatological behavior. Predicting the behavior of annual rainfall would have been essential to modifying agricultural practices and give them the best chance of success.

The *xok k'iin* is based on the assumption that the behavior of rainfall during the month of January predicts the rains for the rest of the year. In Mexico, where traditional agriculture is practiced this popular weather prediction is known as *cabañuelas*. Unlike the regular version of the *cabañuelas*, which only considers the rainfall recorded during the first 24 days of the year, the Maya farmers consider all days of January in their prediction. For Maya farmers, the first 12 days correspond to the 12 months of the year; the following 12 days will also correspond to the 12 months, but in reverse; the next 6 days represent one month for each half day; and on the last day, during the first 12 hours, each hour represents a month from January to December and the final 12 hours represent the months counting backwards from December to January.

The Maya also consider other factors that correlate with the annual rainfall behavior: humidity, winds, clouds, the sun, the moon, fog, the singing of the birds, the way the orioles build their nests, soot, all of which are routinely observed in the first days of January.

Another event for which predictions are also obtained is related to certain atmospheric phenomena. Unlike long-term predictions, these are generated by specific momentary conditions, such as the appearance solar halos or high temperatures and rain shortage during the rainy season, as well as the movement of ants, these are all associated with rain (Caamal, 2015).

1 For this section we rely on information from Bernardo Caamal, CRUPY Report (p.219-220) and the Teran and Rasmussen book, 1994, pp. 135-136.

Annex 10

The names given to the land within the Maya milpa area depending on their state of succession[1]

Name	Description	Years since it was used
K'ubche'	Vegetation composed of small plant shoots during the slash period	First year
Sak'ab hubche' **Kabal pokche'**	Characteristic milpa land	1-3 years
Pokche' k'aax	Very low vegetation	3-4 years
Kabal hubche' hubche'	Low vegetation	4-10 years
Xmehen k'aaxn **Tankelen hubche'**	Small vegetation	10-20 years
Táankelem k'aax **Ka'anal hubche'**	Medium vegetation	20-40 years
Nukuch k'aax **Nohoch k'aax** **Ich k'aach** **Ka'anal k'aax**	Large vegetation	40-100 years
Hobon k'aax	Old vegetation	Over 100 years

1 Source: Modified from Sanabria (1986) and Pérez (1945)

Annex 11

Terms applied to soils located in the hills which are characteristic topography in southern Yucatan[1]

Referential criteria	Maya term	Generic meaning
Reference to the topoform in which these soils are located	Mulu'uch, Chan mulu'uch, Múul, Mulu'uch lu'um.	Names given to the hills or soil located on the hills
Reference to the soils by their specific location in certain topoform conditions	Ho-lu'um, Ho-ruinas.	Name of the crests or peaks or the soil located on them
Reference to the soils by their position in the topoform.	Ka'anal lu'um.	Generic name given to the soils on elevated land
Reference to soil types present in a given topoform.	Box lu'um, Eek'lu'um, Pus lu'um, Pupuski lu'um.	Name given to soil types found only on hills
Unclear or imprecise references	Mulu'ch k'aax, Ya'ax k'aax, Chan táax kabi.	

1 Source: Duch, 2005

Annex 12

Terms relating to physiognomic features of soils in southern Yucatan[1]

Physiognomic feature	Terms in Maya	Generic meaning
Depth	Hach taan lu'um, Taan tan lu'um, Hach taan taan lu'um, Taan k'aan kab.	Very deep soil
	Taan lu'um, K'áan kab.	Deep soils
	Haay lu'um, Tsek'el, Tsek'el lu'um, Ma'taan lu'um.	Shallow or not very deep soils
	Chal tún, Tsek'el lu'um, Hach ma' taan taan lu'um.	Very shallow soils, including rocky soils
Flooding	Tsek'el lu'um, Aa kal che', Koom lu'um, Kaa bal lu'um.	Soils that are regularly flooded and slow to drain
	Pus lu'um, Tan tan lu'um, K'áan kab lu'um, Chac lu'um.	Soils that do not flood regularly and drain quickly

1 Source: Duch (2005)

Annex 13

Terms relating to the morphological features of soils in southern Yucatan[1]

Characteristics	Name in Maya	Meaning in English
Color of soil or surface	Chac lu'um, Chac k'aan kab, K'áan kab lu'um.	Red soils
	Box lu'um, Box k'áan kab lu'um, Eek' lu'um.	Black soils
	Eek' lu'um, K'áan kab, K'áan kab lu'um, Káa kab lu'um.	Brown soils
	Aak'alche', Boxlu'um, Káa kab lu'um, Eek' lu'um.	Grey soils
Consistency (in terms of humidity)	Chich lu'um, Chi chich lu'um, Babahki lu'um, Chich ha'an lu'um, Chich cha ha'an lu'um.	Hard soils
	Hahalki lu'um, Luk' ha'an lu'um, Luk' cha ha'an, Ku hutu lu'um.	Soft crumbling soils
	Pa paa' ki lu'um, Tsaay lu'um.	Thick soils
	Tata'ki lu'um, Papa'ki lu'um, Takluk' lu'um.	Sticky soils

1 Source: Duch (2005)

Annex 14

Terms relating to constitutive properties of soils in southern Yucatan[1]

Property	Maya term	Meaning in English
Texture	Huy lu'um, Hahal lu'um, Hahalki lu'um, Pus lu'um, Sahkab lu'um.	Sandy soil
	Hach huy lu'um, Hach huhuyki lu'um, Hach pus lu'um.	Very sandy soil
	Kat lu'um, Papaa'ki lu 'um, Tata'ki lu'um, Chich lu'um, Aak'alche'	Clayey soil
	Hach, Hach kat lu'um, Hach papaa'ki' lu'um, Aakalche'.	Very clayey soil
Stoniness	Ch'och'ol, Ch'och'ol lu'um, Ch'ech lu'um.	Soil with many large stones on the surface
	Ch'ich' lu'um	Soil with many small stones or fine gravels

"Evaluative. The rating-based nomenclature refers to the soil quality from the perspective of its suitability for agricultural use. The following table lists different designations, (some of these terms have a very literal meaning, such as Ma'alob lu'um, which means good soil) and includes a rating scale (very, regular, little, none) and sometimes includes factors which explain their agricultural suitability (recently plowed, tired, sick)."

1 Source: Duch (2005)

Annex 15

Evaluative terms of soil quality in southern Yucatan with regards to their agricultural use.[1]

Agricultural quality	Maya term	Meaning in English
Fertile soil	Ma'alob lu'um, Eek' lu'um, Káakab lu'um, Chac been lu'um, Sis lu'um	Fertile soil, good for agriculture, recently plowed, fresh
	Hach ma'alob lu'um, Hach tah ma'alob lu'um, Hach sis lu'um.	Very fertile soil or soil that is very good for agriculture
	X'la lu'um, Ma' ma'alob lu'um, Oots'il lu'um, Buy lu'um, Sohol lu'um, Tsek'el lu'um.	Poor or bad soil, or soil that is not good for agriculture
	Ma' hach ma'alob lu'um, Chan ma'alob lu'um, Chac lu'um	Regular soil (or soil that is not good) for agriculture
Unfertile soil	Ka'ana'an lu'um, Ts'o'ok lu'um	Tired soil for agriculture
	K'o ha'an lu'um, Buy lu'um	Sick or bad soil for agriculture
	Tsek'el lu'um, Buy lu'um, Ch'ich'lu'um.	Unproductive soil for agriculture

Several of the thirteen soil types are identified in the descriptive and evaluative criteria. This may be because these taxonomic units are designated by soil features, such as tsek'el for stony soils; or because the name is used categorically, and several soil types share certain features, such as red flat soil or k'áan kab" (Rodriguez, A. et.al., 2016: 223-228).

1 Source: Duch (2005)

Annex 16

Municipalities integrated in the GIAHS Core Zone

Yucatan									
1	Abalá	21	Dzán	41	Mocochá	61	Tecoh	81	Tzucacab
2	Acanceh	22	Dzitás	42	Motul	62	Tekal de Venegas	82	Uayma
3	Akil	23	Espita	43	Muxupip	63	Tekantó	83	Ucú
4	Baca	24	Halachó	44	Opichén	64	Tekax	84	Umán
5	Bokobá	25	Hocabá	45	Oxkutzcab	65	Tekit	85	Valladolid
6	Cacalchén	26	Hoctún	46	Peto	66	Tekom	86	Xocchel
7	Calotmul	27	Homún	47	Quintana Roo	67	Telchac Pueblo	87	Yaxcabá
8	Cantamayec	28	Huhí	48	Sacalum	68	Temozón	88	Yaxkukul
9	Celestún	29	Hunucmá	49	Samahil	69	Tepakán		
10	Chacsinkín	30	Izamal	50	Sanahcat	70	Tetiz		
11	Chankom	31	Kanasín	51	Santa Elena	71	Teya		
12	Chapab	32	Kantunil	52	Seyé	72	Ticul		
13	Chemax	33	Kaua	53	Sinanché	73	Timucuy		
14	Chichimilá	34	Kinchil	54	Sotuta	74	Tinum		
15	Chikindzonot	35	Kopomá	55	Sucilá	75	Tixcacalcupul		
16	Chocholá	36	Mama	56	Sudzal	76	Tixkokob		
17	Chumayel	37	Maní	57	Suma	77	Tixmehuac		
18	Conkal	38	Maxcanú	58	Tahdziú	78	Tixpéhual		
19	Cuncunul	39	Mayapán	59	Tahmek	79	Tizimín		
20	Cuzamá	40	Mérida	60	Teabo	80	Tunkás		

Quintana Roo	
1	Bacalar
2	Felipe Carrillo Puerto
3	José María Morelos
4	Lázaro Cárdenas
5	Puerto Morelos
6	Solidaridad
7	Tulum

Campeche	
1	Calakmul
2	Calkiní
3	Campeche
4	Hecelchakán
5	Hopelchén
6	Tenabo

Annex 17

Action Plan of Dynamic Conservation of the Maya Milpa (2019)

General Objective

To preserve and continue to develop, through a dynamic action plan, the agroecological and cultural experiences of the Peninsular Maya Milpa, driven by culturally appropriate policies to recover the self-sufficiency of the milpa system, ensure biodiversity conservation and rebuild territory for a common benefit.

Specific objectives

1. To form a *Milpero* Council that integrates and represents the *milperos* from each state of the Yucatan Peninsula.
2. To defend the territory by the Maya communities with the intercultural support of civil society organizations, academics and governments of the Yucatan Peninsula.
3. To stop the erosion of the indigenous genetic resources that belong to the peninsular Maya milpa, enrich and maintain their common use.
4. To avoid soil and water pollution.
5. To obtain monetary income through the productive activities of the milpa system while maintaining its diversity.
6. To preserve, enrich and adapt the agroecological knowledge produced by the ancient *milpero* forest management.
7. To recover the lost philosophy, cosmovision and rituals that support and enrich the system, adapting them to new situations.
8. To promote institutional coordination in policies that promote the milpa, and adjust regulations to its agrocultural requirements and practices.
9. To strengthen the best existing milpa practices, promote them and adapt them to the different regions of the Yucatan Peninsula.
10. To recover, preserve and develop the biocultural expressions of the Maya milpa system .

Annex 18

Slashing of monte alto kol o ch'akche' (July-October)

The advantages of carrying it out in this time are derived from the fact that 1) the rains favor a humid and soft vegetation, -that facilitates to cut it- 2) the trees are leafy and their many leaves will serve as fuel, when drying and burning; 3) it gives time to dry well the vegetation that has been cut down; 4) the leaves rot well and form a layer that covers the soil 5) the seeds fall and sprout so that when burned, there are no more seeds and the milpa is clean (this will later translate into fewer weeds and therefore less clearing). If it is burned in January-February (which is more frequent nowadays), 1) the leaves do not rot and when they are burned, the ash is carried away by the wind; 2) since there is no time for the seeds to fall and sprout, the burning does not destroy the seeds and there will be more weeds and the need for clearing.

If it is not slashed in time, the conditions for good burning are reduced, with the positive consequences listed above, and the competition of plants and the work involved in their elimination increases.

When *montes* altos are slashed, a ceremony is held to ask permission from the forest owners, to avoid accidents caused by the bite of poisonous animals and by falling, cut or crushed branches that fall from the trees. In the *montes bajos*, these dangers do not exist and for that reason, they do not always make these ceremonies.

Slash or *sacoleo jan ch'ak*

Sacoleo is the regional term for bush clearing, which comprises cutting bushes, vines and weeds with a machete and a coa. This previous work facilitates the slashing and scares away the vipers, with the prior permission of yum *k'áax*, the vegetation owner.

Cut *kol* o *ch'akche'*

Once the land is cleared, the small trees are cut with an axe and are followed by large trees.

Caution when slashing

The orientation of the bushes. The cut trees should fall towards the interior of the milpa quadrant to facilitate the fire path during the burn.

The height of the stumps. The stumps are left at a height between 0.50 and 1 m., to encourage the plant regeneration. In addition:

1) the milperos' back does not get tense; 2) the trunk is not so thick; 3) if it is slash lower, it can cut the foot 4) the axe can be broken with a stone or blunt faster and 5) the stumps of good species for firewood can be exploited later.

Protection of useful trees. In the past, protecting food plants was essential if we consider that in the years of crisis - which were frequent - these plants were an indispensable resource. Trees for construction and those used for firewood and charcoal have also been preserved. Sometimes large bushes are left, because cutting them involves a lot of work.

P'uyk'am che' shredding

After the slash, the shredding is performed, which consists of cutting with a machete or axe the segments that remain at the moment of the slash, so that a good job is left to facilitate a uniform burning. Two mecates are slashed per day.

Slash of the *monte mediano kelenche.*

The slash of the *monte mediano* follows the same procedure as that of the *monte alto*, except that it starts later (November-January) so that the sprouts do not grow so much and the dry vegetation burns well.

Slash of the *monte bajo kol kelenche'*.

It is done during January and February and consists of clearing the land with a machete and a coa because the trees are smaller and thinner, so no axe is required.

Aporreo *putch saka* and chapeo de la cañada (canyon plowing)

The "aporreo" is to cut down the corn stalks of the 2nd and 3rd year milpas with a stick. It is done practically when it is going to be burned, -in March, April or May-, because the weeds, in three days are already dry. At the same time, the chapeo is performed, which comprises cutting the grasses and corn stalks of the 2nd and 3rd year milpas with a coa and a machete.

Guardrail *mis pach kol*

Around the cleared land to be burned, a strip of ground is cleaned to prevent the fire from spreading to the surrounding *montes* or milpas during the burn and also to leave a path open to facilitate movement around the milpa.

The branches and weeds are removed with a coa, machete and by hand. The path is swept with a broom made of branches or *mis ch'ilib.*

Burning *to'ok*

Burning in milpa-roza is more complex than burning in cañadas.

When the vegetation is dry and the rains are close (mid-March to mid-May), the burning season begins when the winds coming from the south, southeast and east are warm and blow uniformly. When the milpero considers it is going to rain and has spent at least a week with sun, he chooses a day, preferably sunny, and prepares to burn. The soil must be dry and hot.

The burning is done by at least two people and it is quick (1/2-hour, 3/4-hour, 1 hour), although it takes half a day for preparations. Before the burning, the land is walked around making noise so that the animals get out and do not get burned. It is a duty to warn them. A ceremony is also performed in which a jar with sakáj, a ceremonial drink that is dedicated to the winds to favor a good burning, is placed in the center of the land to be burned.

Before burning, with wood that cracks easily and burns well, being dry or green, the torches or taj che' are prepared, making several longitudinal cuts that are then tied with vines.

With their torches, the two burners go to some opposite point to the south (it can be southwest, northwest or northeast) and from there they walk along the guardrail, towards different sides and distributing the fire as many times as possible.

When the wind stops blowing, they whistle to call it. It is fatal that it stops blowing, that it changes direction, or that it rains. A good burning depends not only on knowledge but also on luck.

At the end, a count of burned animals is made, to ask forgiveness to the owner of the animals during the rain ceremony that is held after the sowing.

Annex 19

Photographic illustration of the Maya Milpa Cycle

A photographic sequence of some parts of the process is presented regarding the diagram presented above, which is the explanation of the cycle of the first 3 years contained in Chapter III.A.3.10 Milpa Cylce and Chapter IV-1.1: Infograpfic of the Peninsular Maya Cycle:

1. Site Selection

MILPERO IN PROPER SITE SELECTION. PHOTO: GILBERTO M. GONZÁLEZ KUK

PREPARATION OF THE *K'OL* IN A CEREMONY FOR THE SELECTION OF THE JEETS' LU'UM PLOT IN TELCHAQUILLO, TECOH, YUCATAN. JULY 2019. PHOTO: ADOLFO RODRÍGUEZ CANTO

2. Breaching-Measuring-Clearing

WOMEN MILPERAS CLEANING AND CLEARING THE LAND FOR THE MILPA. PHOTO: THE NATURE CONSERVANCY

3. Burn

TRADITIONAL MILPA IN KANTUNIL, YUCATAN, IN WHICH FOREST TREE SPECIES ARE PRESERVED DURING THE SLASH. MARCH 2015.
PHOTO: ADOLFO RODRÍGUEZ CANTO

GUARDRAIL IN A TRADITIONAL MILPA IN THE VALLADOLID-TIZIMÍN ROAD, YUCATAN. MARCH 2015.
PHOTO: ADOLFO RODRÍGUEZ CANTO

4. Seeding

MILPEROS DURING SEED DISPERSAL PROCESS. PHOTO: HTTP://WWW.YUCATAN.GOB.MX/ RETRIEVED, AUG 2022

5. Kool, Doba and Polyculture

MAIZE AND SQUASH IN A CONTINUOUS MILPA. PHOTO: ADOLFO RODRÍGUEZ CANTO

MAIZE AND SQUASH IN A CONTINUOUS MILPA. PHOTO: ADOLFO RODRÍGUEZ CANTO

ASPECT OF A MODERN PACH PAK'AL OF A TRADITIONAL MILPA, IN TIXCACAL GUARDIA, FELIPE CARRILLO PUERTO, QUINTANA ROO. JUNE 2015. PHOTO: ADOLFO RODRÍGUEZ CANTO

FOLDED MAIZE AND JICAMA IN A CONTINUOUS MILPA IN MAXCANÚ, YUCATAN. THE JICAMA IS PLANTED TWO WEEKS AFTER THE MAIZE, AND WHEN THE MAIZE IS RIPE, IT IS HARVESTED WITH THE WHOLE PLANT SO THAT ONLY THE JICAMA REMAINS. NOVEMBER 2015. PHOTO: ADOLFO RODRÍGUEZ CANTO

6. Harvest

***PIIBIL NAL* PREPARATION (CORN COOKED UNDERGROUND) IN WILSON'S MILPA. CANDELARIA, QUINTANA ROO. OCTOBER 2018. PHOTO: SHERIE RAE SIMMS**

**MILPA STORAGE.
PHOTO: ADOLFO RODRÍGUEZ CANTO**

**YUCCA ROOT EXTRACTION IN A TRADITIONAL MILPA IN YALCÓN, VALLADOLID, YUCATAN. MARCH 2015.
PHOTO: ADOLFO RODRÍGUEZ CANTO**

MAKAL HARVEST IN A TRADITIONAL MILPA IN YALCÓN, VALLADOLID, YUCATAN. MARCH 2015. PHOTO: ADOLFO RODRÍGUEZ CANTO

Annex 20

The Peninsular Maya Milpa and the Sustainable Development Goals: 2030 Agenda

We consider that the proposal of the peninsular Maya milpa as a GIAHS is aligned with 9 of the 17 aims (almost half), and with the 18 goals, set out in the 2030 Agenda for Sustainable Development, formulated by ECLAC for Latin America and the Caribbean.

This means that the GIAHS peninsular Maya milpa project contributes significantly to the fundamental change that seeks the implementation of this Agenda, and to resolving of critical issues for the sustainable development of the region in which it is inserted.

Below, we will describe how the GIAHS peninsular Maya milpa project is aligned with the Aims and Goals of the 2030 Agenda, and discuss the ways in which dynamic conservation of the Maya milpa will work to achieve these goals.

1. No poverty

Aim: To end poverty in all its forms, worldwide.

1.5. By 2030: Successfully ensure adequate resilience of the poor and vulnerable, and reduce their exposure and susceptibility to extreme climate-related events, other economic and social disruptions, as well as environmental disasters.

The milpa comprises *milperos* whose system has already showed great resilience by existing for almost 3,000 years. However, in recent times, due to the loss of space and integrity, the ancestral structure has shown vulnerability to economic, social, and environmental disasters. The GIAHS project seeks to reinforce the resilience of the milpa, reduce the risk of impoverishment of peninsular Maya *milperos*, and reverse the

1.a. To ensure a significant mobilization of resources from diverse sources, it is necessary to improve communication and cooperation for development. To supply adequate and reliable resources to developing nations, particularly the under-developed ones, there must be an implementation of programs and policies to end all ravages of poverty.

With the GIAHS certification, we will be in a better position to support the efforts of the peninsula Maya milpa to obtain the resources they require from various national and international sources, and thus achieve the aims of conservation and development of the system.

2. Zero hunger

Aim: To end hunger, achieve food security, improve nutrition, and promote sustainable agriculture.

2.1 End hunger by 2030, and ensure that healthy, nutritious, and sufficient food is accessible year-round, for those who are currently poor and vulnerable – and even more urgently – their children under the age of one.

As mentioned above, the milpa provides high-quality nutrition because the three species that comprise the core of the polyculture – corn, beans, and squash – contain all the nutrients the human body requires: carbohydrates, proteins, fats, vitamins and minerals. The conservation of the milpa system in the Yucatan Peninsula promotes access to healthy, nutritious and sufficient food for the poor sectors of the region, such as *milperos* and their families.

2.4. By 2030, we must ensure the sustainability of food production systems and implement resilient agricultural practices that increase productivity and production, contribute to the maintenance of ecosystems, and strengthen resilience to climate change and extreme weather events, such as droughts, floods and other disasters. Improving land and soil quality must also be prioritized.

The milpa production system, as we saw in the previous section, is highly resilient due to best practices: 1) by selective tree cutting, creating firebreaks, and, more recently, incorporating tree hedges that improve forest management and help prevent disasters. 2) continuing efforts to strengthen seed adaptability to drought, flooding, and burns. 3) improve the milpa soil, and increase productivity by developing seeds that adapt to changes, particularly climate change. 4) promote crop diversity and the use of organic fertilizers as production practices in vegetation management. 4) strengthen the bonds of families and community organizations.

2.5. By 2030, the genetic diversity of cultivated seeds and plants, as well as farm animals, domestic animals and associated wild species, will be achieved through effective management, diversification of seed and plant banks, at the regional, national, and international level. The benefits of the utilization of genetic resources, which are associated with traditional knowledge, fair and equitable sharing – as stipulated in international agreements – will be widely accepted thanks to educational campaigns that inform and empower the population.

The essence of milpa polyculture has been to support and develop cultivated genetic material that helps the system to face the permanent challenge of climate variability. Strengthening the genetic diversity of seeds, cultivated plants, and wildlife is an integral element of the milpa system, and an aim of the GIAHS project. The milpa system is aware of the importance of this goal, which consists precisely in preserving and developing the genetic diversity that has characterized it. This has been achieved by working permanently on the adaptation of seeds in each of the milpas. Each *milpero* is a plant breeder and this must be reinforced by promoting and validating their work. Community germplasm banks must be maintained. As previously described, the conservation and development aim is also applied in the milpa system with farm animals (pigs, chickens and turkeys) and in beekeeping.

8. Decent Working Conditions and Economic Growth

Aim: To promote sustained and sustainable economic growth, full and productive employment, and decent working conditions for all.

8.3 Promote development policies that support productive activities, the creation of decent jobs, entrepreneurship, creativity and innovation, and that promote the formalization and growth of micro, small and medium-sized enterprises that also have access to financial services.

The Milpa is a multi-faceted productive system that is currently not supported, nor respected, as it deserves. In fact, in the Yucatan peninsula, there have been sustained efforts to completely eliminate this traditional way of life and patrimonial agricultural system. Large-scale cattle ranching and mega-agricultural interests have been deemed more profitable. The aim of the GIAHS project is to strengthen the productivity and sustainability of the Milpa system. In addition to support of agricultural aims, it is important to strengthen complementary activities that are also belonging to the milpa system, such as embroidery, beekeeping and tourism. These can and should be promoted as micro-enterprises to generate money for the system.

8.4. By 2030, under the "10 Year Framework of Programs on Sustainable Consumption and Production", the gradual but consistent strengthening of systems that require assistance to achieve production goals and meet its resource-efficient consumption target. The achievements of these systems will help to disrupt economic programs that degrade the environment.

Since the peninsular Maya milpa has decreased, because systems such as cattle ranching or commercial agriculture have been promoted; the GIAHS certification would collaborate in decoupling economic growth from environmental degradation.

8.9 By 2030, develop and implement policies aimed at promoting sustainable tourism to create jobs, promote culture and stimulate production of local products.

MEN IN MILPA. PHOTO: IVAN LOWENBERG

An activity that supports the economy of milpa communities is ecotourism (which incorporates vacation experiences with responsible use of the landscape, knowledge of birds, *cenotes*, and other eco-attractions). Cultural tourism (visiting Maya family households, respectful participation in celebrations, agricultural rituals, etc.) is another source of income that works well when operated within a sustainable community framework.

10. Reduction of Inequalities

Aim: To reduce inequality within and between countries.

10.1 By 2030, gradually achieve and sustain income growth for the poorest 40% of the population at a rate above the national average.

MEN IN MILPA. PHOTO: IVAN LOWENBERG

Milperos in Yucatan currently have such a low income that they must buy corn to feed their families. With the GIAHS project, it is expected that they will be the first to access food self-sustainability and achieve greater income from the sale of products from the milpa system activities such as honey production, handicrafts, animal husbandry, specialized tourism, etc.

11. Sustainable Cities and Communities

Aim: To make cities and human settlements inclusive, safe, resilient and sustainable.

11.4 Intensify efforts to protect and safeguard the world's cultural and natural heritage.

The peninsular Maya milpa is a system that has maintained the forests of the Yucatan Peninsula for 3000 years because it depends on them, and along with the forest, its culture has also been preserved and developed, as it is organically linked to natural resources (food, rituals, material culture, cosmology, philosophy, literature). Therefore, protecting the Maya milpa is synonymous with protecting the biocultural heritage of the Yucatan Peninsula.

11.5 By 2030, the aim is to significantly reduce the number of deaths caused by disasters, including those related to water. Direct economic losses and people affected by these events must be reduced. Global gross domestic product must place special emphasis on protecting the poor and those living in vulnerable situations.

To protect the poor population of the Yucatan Peninsula, mainly formed by the Maya, from disasters caused by hurricanes that recurrently affect the area on a recurring basis, the conservation of the peninsular Maya milpa is strategic. As mentioned above, the milpa system features multi-level practices that result in resilience. The disappearance of the peninsular Maya milpa system would leave the impoverished population of the peninsula vulnerable to all types of disasters, but especially to climate phenomena. Only conservation and development promote resilience in the face of natural disasters of all kinds.

11.b By 2030, it is necessary to significantly increase the number of cities and human settlements that 1) adopt and implement integrated policies and plans to promote inclusion and resource efficiency, 2) climate change mitigation / adaptation and disaster resilience, 3) the development and implementation of a comprehensive disaster risk management at all levels, which is in line with the Sendai Framework for Disaster Risk Reduction 2015-2030.

12. Responsible Production and Consumption

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Aim: To ensure sustainable consumption and production.

12.2 By 2030, achieve sustainable management and efficient use of natural resources.

The peninsular Maya milpa is a system that has produced a nutritious and complete diet that does

not damage natural resources. At present, given the scarcity of fields, the continued use of soil with organic inputs and few chemical inputs should be promoted, as practices that promote biodiversity conservation, these actions will contribute significantly to achieving the designated goal.

12.4 By 2030, the goal is to achieve environmentally sound management of chemicals and all waste products throughout their life cycle – in line with international frameworks that significantly reduce release into the atmosphere, water and soil – thus minimizing adverse effects on human health and the environment.

The traditional peninsular Maya milpa makes no use of chemicals and, although it burns vegetation for two years, it replenishes it over longer periods, so at the end, it cleans the atmosphere more than it pollutes.

Nowadays, the more traditional milpa uses very few agrochemicals to compensate for the reduced fallow times. Continuous milpas burn only one year to clear the land for cultivation and then try to use organic inputs and few chemicals. Secondary vegetation during milpa fallow periods, sequesters carbon dioxide.

13. Climate action

Aim: To adopt urgent measures to combat climate change and its effects.

13.1 There is a great need to strengthen resilience and adaptability to climate-related risks and natural disasters in all countries.

We have mentioned that the peninsular Maya milpa has proven to be a highly resilient system for many reasons, and because it supports domesticated and wild biodiversity (highlighting the forging of drought-and-flood adapted seeds). Therefore, to reinforce the milpa is to strengthen our adaptation to climate-related risks.

15. Life of Terrestrial Ecosystems

Aim: To promote the sustainable use of terrestrial ecosystems, combat desertification, stop and reverse land degradation and halt biodiversity loss.

15.1 By 2030, we must ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, particularly forests, wetlands, mountains and arid zones, complying with the obligations derived from international agreements.

The peninsular Maya milpa has been a sustainable system, and its crisis is due to the increased cattle ranching and commercial agriculture projects which have grown at the expense of milpa land. With the GIAHS project, a milpa zone would be established and that would stop the expansion of cattle ranching and commercial agriculture. This would protect the forest to ensure the conservation and restoration of the sustainable use of the forest associated with milpa.

17. Partnerships for the Goals

Aim: To strengthen the means of implementation and revitalize the global alliance for sustainable development.

Although the peninsular Maya milpa is not a government, nor a civil organization, nor a company, if a GIAHS zone is formed, in which the *milperos* that inhabit it establish common agreements and activities, it can operate as an alliance zone to promote the goals of the 2030 Agenda. This would be possible, above all, if the GIAHS certification affects the strengthening of the Maya milpa.

PROPOSAL FOR THE RECOGNITION OF THE ICH KOOL: MAYAN MILPA OF THE YUCATAN PENINSULA MEXICO, AS A GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEM

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