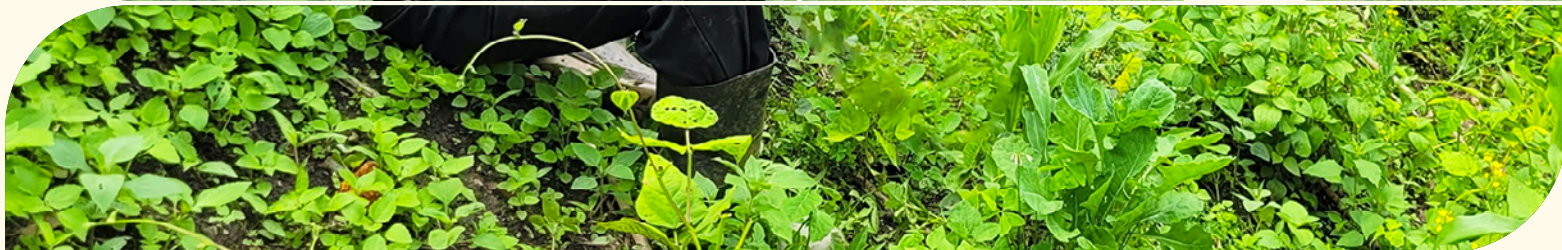


A MAYA-ACHÍ COMMUNITY'S ROAD TO CLIMATE ADAPTATION:

A portrait of Xesiguán



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ACPC actively contributed to the development of this research in different ways. ACPC introduced the researcher and data collector to the rest of the community and invited her to different events that increased community engagement. The research assistants, Doña Blecín Rubilia Lajuj and Sheilyn Amarilis Osorio Cortez, were also leaders in the ACPC Women Committee and the ACPC Young Committee respectively.



Ethical considerations

Research approval obtained from the UNBC Research Ethics Board. Consent for the inclusion of real names and photos was obtained for this research.

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Key informants

Andrés Gabriel López Cajbon, William Ixpatá Ixtecoc, Juana González Ixpatá, Ostilio González, Florimalda González.

The researcher

The researcher, originally from Peru, holds a Master's degree in International Studies from the University of Northern British Columbia. Her Latin American background and native Spanish language contributed with a deep contextual understanding to the study. This research was conducted as part of her master's studies, and it is part of the Indigenous People's Observatory Network (IPON), which is a network that has already been working on the mission to integrate Indigenous knowledge into global sustainability efforts to address food security and health issues. IPON is a project focused on the food-climate-health nexus. Rubi's thesis was supervised by Dr. Tristan Pearce, and guided by Dr. Catherine Nolin and Dr. James Ford. Dr. Nolin's long-standing relationships and experience in the region helped facilitate the research process.

Research aim and methodology

This research aimed to identify the conditions to which small-scale farmers from Xesiguán village in the Rabinal area, department of Baja Verapaz, Guatemala are exposed and sensitive to, and their associated adaptive capacities. This research was carried out through a bottom-up approach to climate change vulnerability research, which places people at the forefront of the analysis. Data collection happened from May

to July 2025 through semi-structured interviews with 27 community members, and conversations with 5 key informants. The key informants were people who do not live in Xesiguán, but that work with farmers from Xesiguán. Interviews were conducted along with participatory mapping, participant observation, and analysis of secondary sources (i.e., climate data).



Two Maya-Achí research assistants were hired to ensure that cultural protocols, values and language preference were respected when approaching to each participant:

Doña Blecin Rubilia Lajuj



Sheilyn Amarilis Osorio Cortez



This research started by identifying the societal and environmental conditions that are relevant for the Xesiguán's community members, and by understanding their perceptions of how climate change is impacting in their daily lives. This research also identified the strategies they are using to adapt to environmental changes.

Research location

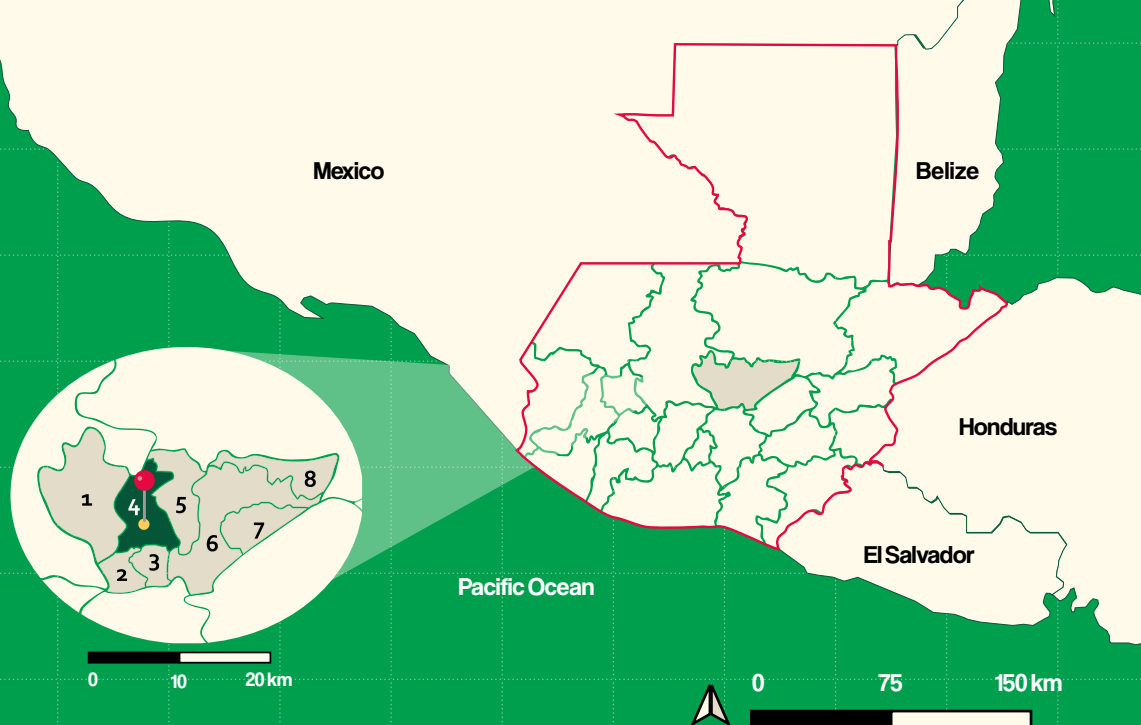
Study area

/ Legend /

 Guatemala

 Rabinal

 Xesiguán village



The Xesiguán village is located in the Central American Dry Corridor, which is an area of land of about 1,600 kilometers and that crosses different countries such as Costa Rica, Nicaragua, Honduras, El Salvador, and Guatemala [1]. Guatemala makes up 22% of the total region of the Central American Dry Corridor [2]

Xesiguán belongs to the municipality of Rabinal, department of Baja

Verapaz, which is home to the Maya-Achí people. In Baja Verapaz, 60% of the population are Indigenous, and in Xesiguán, 95% of the population are Indigenous [3].

Xesiguán is a mountainous area, and its residents have a close relationship with their environment. They depend on farming for their livelihoods, and they have a strong connection to their land.

Population and historical context

Guatemala is a country that holds a lot of diversity and a significant Indigenous presence. According to the United Nations High Commissioner for Refugees and the Minority Rights Group International, about 60% of the population is Indigenous [4,5]. Guatemala's Indigenous groups include Maya, Garifuna and Xinca [3]. The Maya, being the largest Indigenous group representing 41.66% of the Guatemalan population, has 22 subgroups according to their languages [3].

Historically, the Central American Dry Corridor, home to the Maya civilization, faced centuries of drought, which posed a significant threat to agricultural production [6]. There is extensive literature that indicates that Maya's history started at least 3,000 years ago, during the Middle Preclassic Period [7,8]. The Mesoamerican Research Center even mentions that before that period, there has been evidence of burning and cultivation of maize in Petén, Guatemala, during the Early Preclassic Period [9]. Due to their

long-term experience in facing these external stressors, the integration of Maya traditional knowledge becomes of great value in times where climatic conditions have exacerbated.

Guatemala is still recovering from 36 years of state-sanctioned violence and genocides [10]. Its history is full of atrocities and human rights violations that are linked to land tenure and racism towards Indigenous communities, contributing to impoverished conditions and land dispossession. The Maya-Achí population was one of the Indigenous groups targeted for such violence and, therefore, the current residents of the Maya-Achí area are survivors of the genocides [10,11]. Previous research identified that community members from Xesiguán, in the Rabinal region, reported that they are more impoverished now because they lost everything that they had during this period of violence [12]. Despite these impacts, the Maya have demonstrated resilience by overcoming multiple challenges throughout their history, including decades of droughts [13].



Importance of the rain for the Maya-Achí

For Maya-Achí communities, the rain is a very important part of their lives. It not only provides water security, but also allows them to work and provides food security. When rain occurs, it contributes to the growing of their crops, therefore rain is connected to their work activities and their food. Additionally, rain is also important for the Xesiguán's cultural activities. For example, every start of May, after the second or third

rain, community members wake up about 1 a.m. to 3 a.m., put their boots on, and go insect catching. As it is dark at night, it is possible to see their lanterns or flashlights that illuminates the landscape. They catch alive zompopos, which are also known as leaf cutter ants. Community members usually refer to them as "Zompopos de mayo" because they come in May due to the start of the rainy season. After

grilling the insects, they wash them and eat them. A few participants reported that they do not eat them, they just catch them because it is their tradition. After years of observation, community members have understood the behavior of zompopos, and they know when they are going to come out, as their behavior is closely linked to rain.



Another example that is closely related to rain is the dances they perform. There are different cultural activities happening throughout the year and they participate dancing, usually in the Rabinal town center.

Los Costeños is a dance where they pray for rain, and this usually happens by the beginning of May because it is when the rainy season usually starts.

Another example is Los Huehuechos, in which dancers dress as elders and pray.

Crops and river

As part of the Maya culture, their main crop is milpa, which is an ancient polyculture system that consists of maize, beans and squash. Other crops they usually plant in Xesiguán are coffee, tomato, onion, string beans; and different edible plants like apazote, macuy, bledo, cilantro. Among the fruits they plant are oranges, zapotes, bananas, peaches, jocotes. As for animals, most farmers have cows, goats, chickens, mules, pigs, turkeys, ducks.



Background



Their main source of water is the Xesiguán River, Chixim River, and natural springs coming from the mountains.

Main findings

Xesiguán farmers have experienced different climate change impacts such rising temperatures, intense rainfall and changes in hydrological cycles. According to the National Institute of Seismology, Vulcanology, Meteorology and Hydrology (INSIVUMEH), there is no weather station in Xesiguán, but the closest station in Cubulco has reported a temperature of 41.2 °C in 2024, which was higher than the temperatures in the last 19 years (Table 1). These instrumental data are consistent with what participants of this research have reported for the Xesiguán area.

Table 1: Average and Maximum Air Temperature, 2005-2024 - Cubulco weather station

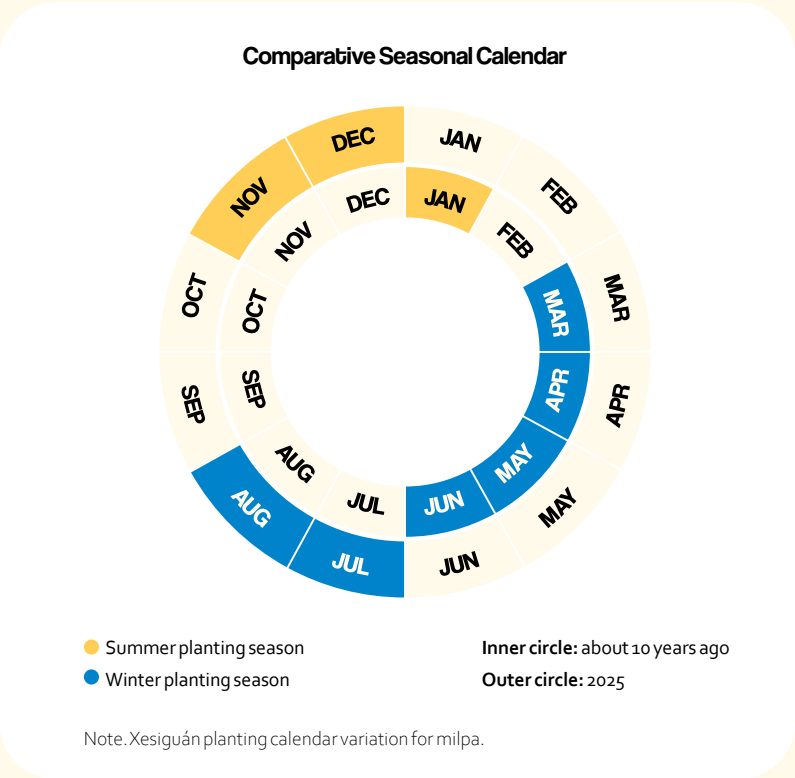
Year	Average	Max
2005	30.31	38
2006	30.31	37.2
2007	30.59	37
2008	27.86	35.6
2009	30.54	37.4
2010	30.31	39
2011	30.16	37.2
2012	30.04	35.4
2013	30.26	37.8
2014	30.23	37.4
2015	30.88	40
2016	31.27	38.8
2017	30.98	39.4
2018	31.2	37.4
2019	31.86	38.6
2020	31.2	39.2
2021	31.03	39.4
2022	30.85	39.4
2023	32.03	38.6
2024	32.33	41.2

Note. Elaborated with raw data provided by INSIVUMEH [14]

Current impacts

Changes in their planting times

Participants have reported their concerns regarding drought. They have uncertainty because rainfall times are changing, and therefore, their planting times are changing as well. A calendar was elaborated according to their responses:



Current impacts

Changes in river water levels

Participants reported that when they were children, crossing the river was not an easy task because it carried a lot of water. They said that nowadays, crossing the river is possible because river water levels have reduced due to increasing drought. Another change participants have reported is regarding the lack of sound. They reported that they could hear the river even from the top of the mountains and they recall the sound as part of their childhood memories.

Spanish

"Hoy ya no escucho la voz del río"

Translation

"Nowadays, I do not hear the voice of the river anymore"

Doña Alberta Gallego Bolaj

Spanish

"Los tiempos vienen cambiando, la sequedad, el agua ya no se escucha, el agua desaparece"

Translation

"Times are changing, the dryness, water is no longer heard, water disappears"

- Don Feliciano Acqj Cuxum

Note. Doña Josefina
Cajbon Tecu by the river.



Current impacts

Soil fertility has decreased



Participants have reported that the intensive use of chemical products have decrease the soil fertility.



"(Antes) La tierra era muy fértil"
"(Before) The soil was very fertile"

Doña Juana González Ixpatá

Increase of plagues



Participants reported an increase in crop pests affecting their milpa, coffee and some of their fruit crops. One example they provided is the way their coffee is impacted by the Coffee Leaf Rust (CLR), known by farmers as '*roya*'. CLR is a fungal disease caused by *Hemileia Vastatrix*, which favours temperatures between 21°C to 27°C and dark humid environment [15]. Other scholars have confirmed the CLR is a climate-related diseases that impacts farmer's crops [16]

Don Juan Carlos Gonzáles Córdova informed that climate change has increased plagues and that now they have to use insecticides, which they did not use before.



Note. Doña Mayra showing some plagues in her milpa crop.



Death of poultry



Participants said that when the chickens' bodies are warm due to hot weather, followed by cooler and wetter conditions from sudden rainfall, the body temperature of the chickens cools too quickly causing them to die.

The death of chickens undermines families' food security and income capacity. Some participants eat the eggs and meat; others sell them. When they are left with no eggs or meat to eat or sell, it becomes a concern for participants' livelihoods and food security.



Todos mis pollitos se murieron, ¡todos! No quedó ninguno. ¡Tenía 60 y el último se murió ayer! (...) Yo nunca he vacunado a mis pollos y siempre sobreviven a la peste, pero esta vez todos se murieron.

All my chickens died, all of them! Not a single one was left. I had 60, and the last one died yesterday! (...) I have never vaccinated my chickens, and they always survive the pest, but this time they all died.

Don Feliciano Acoj Cuxum

New World Screwworm Fly (NWS)



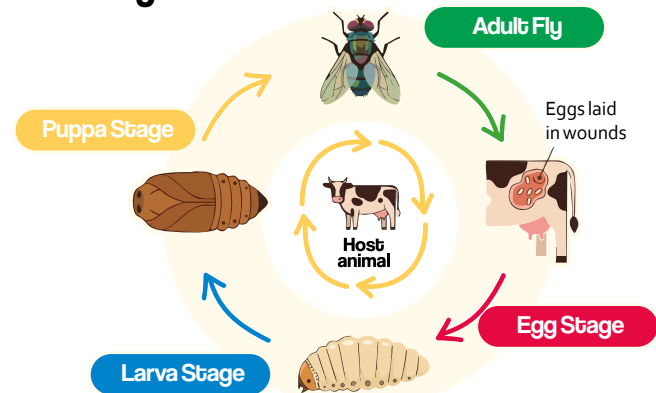
Another pressure that has affected livestock health in Xesiguán is the spread of the screwworm fly. This fly is the adult version of the New World Screwworm (NWS), which is scientifically known as *Cochliomyia Hominivorax* [17]. One of the key informants, William Ixpatá Ixtecoc, explained that these Screwworm Flies always look for a wound in the animal, even a small cut provides an ideal place for these flies to lay their eggs, where larvae can feed and grow by eating the tissues of the host animal. After the larva has grown, it comes out of the host animal and drops to the ground and buries itself to turn into a pupa. Afterwards, this pupa turns into a fly that looks for wounds to repeat the cycle.

Participants realized that the NWS was affecting the animals through observation of unusual animal behavior. For example, Don Mario Rene reported that he saw one of his cows was sad, mad, and scared at the same time. He mentioned that the cow would jump anytime anybody was around and did not want to eat. By closely observing his cows, he realized that there was a wound with pus and blood coming out of its chest. This case highlights the importance of the expertise that farmers have regarding livestock behavior. It is relevant to mention that he was able to realize it was the NWS infestation due to information about previous cases provided in ACPC's workshops. NWS is also attacking other animals such as pigs, dogs, and birds, as reported by other participants.



Note. Affected cow prior to being assisted.

Life cycle



Adaptive strategies

Knowledge transmission: 'The good path'

As Xesiguán is being impacted by climate change, community members are continuously implementing different strategies to deal with and adapt to these changes. These strategies are based on their ancestral agroecological knowledge. All participants informed that knowledge transmission is imperative for their livelihoods. The majority of participants reported that they learned to work with their land between the ages of 8 to 12.

Community members think that if their children do not learn the 'good path', they might end up on drugs, gangs, or stealing from their neighbors, which is what they call 'the bad path'. In this instance, knowledge transmission in Xesiguán is a tool that encourages the new generations to contribute to society, instead of being a detriment to it. They are teaching their children ways to be food secure, so that they do not

turn to crime for survival. Knowledge transmission is part of Xesiguán's adaptive capacity, which is also used as a strategy as it contributes to self-sufficiency in the community

It is important to highlight that according to the 2018 census, only 40 people are older than 55 years of age [3]. Such a finding means that there are fewer people to transmit their knowledge for the next generation. Despite the small number of community knowledge holders, participants continue passing their knowledge from generation to generation. This knowledge transmission contributes to the generational sharing of their environmental knowledge about the management of the Dry Corridor region.

(...) Para que ellos aprendan a trabajar y no que después aprenden malas cosas, porque si uno no les enseña a trabajar, los niños nunca aprenden y lo que hacen ya más grandes es que buscan otro camino, porque ellos no se han acostumbrado a trabajar. Entonces ellos quieren tener pisto, pero así a lo suave. Entonces por eso, yo les enseño así a trabajar para que ellos aprendan y ya cuando están más grandecitos ya saben trabajar.

(...) So they learn to work and not learn bad things later, because if you do not teach them to work, children never learn, and what they do when they're older is look for another path, because they have not gotten used to working. Then they want to get money but in an easy way. So that is why I teach them to work this way, so they learn, and when they're older, they already know how to work.

Doña Maria Santos Ixpatá

Note. Don Tomás
Acój Cahuec

Adaptive strategies

Steps for the future

Agroecology

It is rooted in ancestral farming and has become a tool to increase community resistance to the new and modern ways of farming [18]. In the community, some participants indicated that increased plagues and soil degradation have pushed them to use the modern tools for farming.

However, all of the participants indicated that they are convinced that using the ancestral farming techniques is the best option because it is predicated on healthy relationships with nature, and they aim to return to those agroecological practices.



Lombricompost

This strategy involves the use of red worms that community members called '*Lombrices Coquetas Rojas*'. These worms break down organic waste to turn into compost which they use for their planting season. Don Alfredo promotes this strategy that he had first tried himself in his house. He has a box made of wooden pieces where he has earth and a lot of worms. When his family eats fruits or vegetables, they put the fruit and vegetable peels in the Lombricompost box, and the worms contribute to the fast breaking down of such waste, which is used as a soil fertilizer after. Don Alfredo calls the red worms their fieldworkers because they help him to plant better during the planting season.

Don Alberto has also adopted this strategy, and he welcomes members from other communities in his farm to talk about the success of Lombricompost:



Biochar

It is an agricultural strategy implemented in 2023 that helps to capture moist in the earth and drip it little by little simulating a drip irrigation (A. López Cajbon, personal communication, July 3, 2025). Biochar directly irrigates the root area, reducing water waste. Biochar is similar to carbon, but it goes through a process of pyrolysis as participants and key informants reported. Biochar is very easy to get because as it is made of dry wood that is found in their ecosystem. Farmers only take the pieces of wood that had fallen from trees due to strong wind (A. López Cajbon, personal communication, July 3, 2025).



Note. A piece of biochar.

Adaptive strategies



Mountain Microorganisms (MM)

Mountain Microorganisms are a group of fungi and bacteria that recover the soil health (A. López Cajbon, personal communication, July 3, 2025). Participants informed that the use of mountain microorganisms help retain humidity in the earth, it improves the metabolism of the plants and the production of their crops. Mountain microorganisms can be found in virgin forests. Through a 2022 project, ACPC got a biofactory, where they continue to reproduce the MM for different purposes (A. López Cajbon, personal communication, July 3, 2025). Some other uses are natural fertilizers, natural pest repellents and fumigants. Sometimes, community members mix chicken manure with MM as fumigant. ACPC encourage farmers in different areas, including Xesiguán, to continue using MM to improve productivity in their crops.



Suarlin Cortez Canahuí explained to young people the processes and advantage of reproducing mountain microorganisms:



Note. Solid mother culture.



Note. Liquid mother culture.



Note. MM in the virgin forest.

"Nuestros ancestros ya sabían de esto, nosotros solo estamos regresando a ello".

"Our ancestors knew that already, we are just going back to it."

Andrés López Cajbon



Drought-resistant grass

Participants and key informants reported that forage grass is not growing as fast as before, because it needs water to grow. For that reason, community members are trying to find ways to overcome that difficulty by introducing new types of grass. For example, Brizantha is a type of forage grass that some participants reported that they are trying, because it retains more water and is more resistant to drought [19]. One of the key informants, William Ixpatá Ixtococ informed that he was testing with another variety from Brazil. All of these tests reflect their efforts to find new ways to fight drought difficulties.



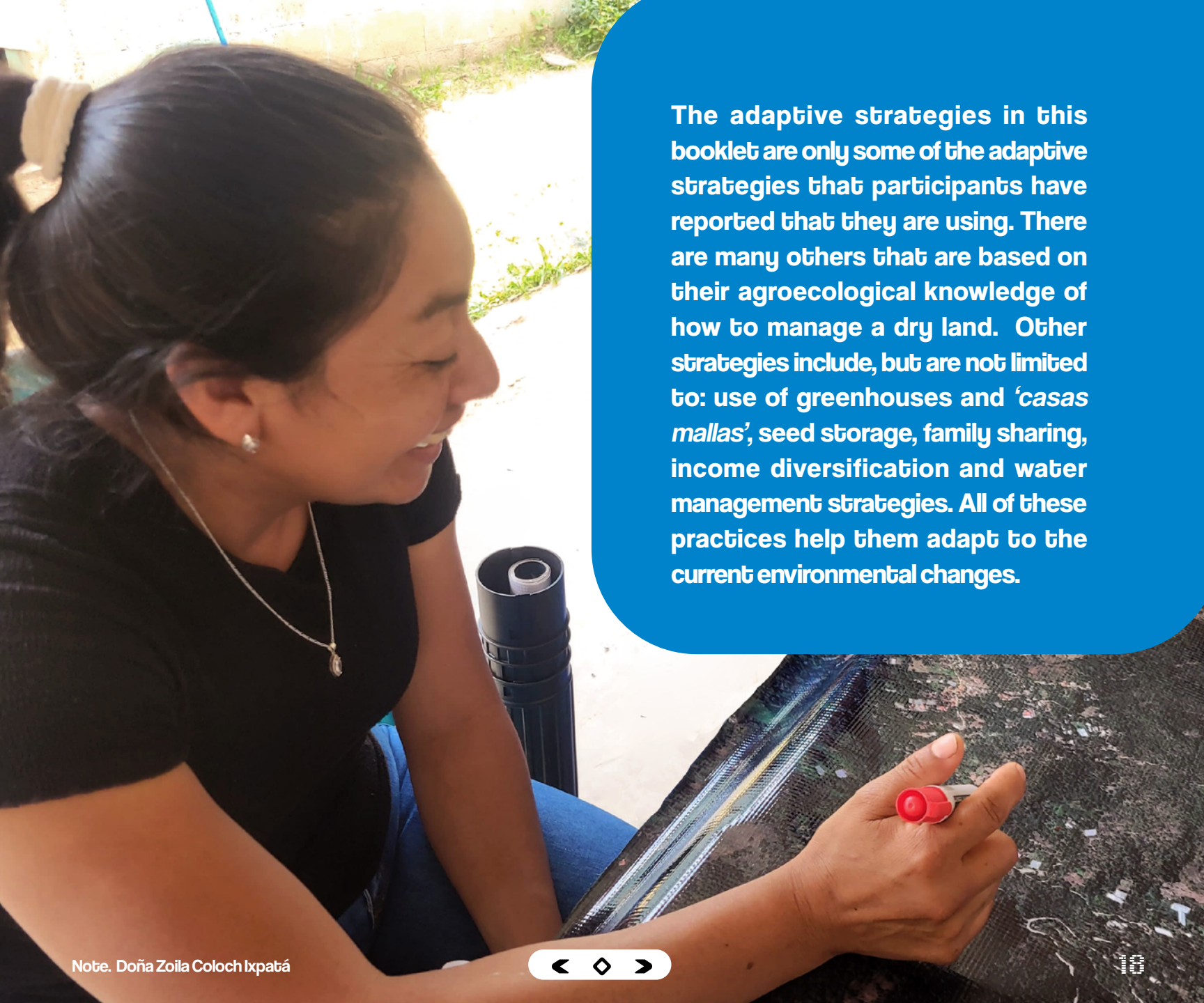
Note. William Ixpatá Ixtococ.



Es de pastoreo, tiene una altura aproximadamente de 80 centímetros. (...) Es un mejoramiento de pasto que nosotros estamos introduciendo.

It is for grazing, approximately 80 centimeters high. (...) It is an improved type of grass that we are introducing.

Suarlin Cortéz Canahuí



The adaptive strategies in this booklet are only some of the adaptive strategies that participants have reported that they are using. There are many others that are based on their agroecological knowledge of how to manage a dry land. Other strategies include, but are not limited to: use of greenhouses and '*casas mallas*', seed storage, family sharing, income diversification and water management strategies. All of these practices help them adapt to the current environmental changes.

Table 2. How adaptive strategies contribute to managing current changes

The following table shows how Xesiguán community members are using several strategies to reduce the impacts of the current changes they are experiencing. By implementing these strategies, they continue on the road towards climate change adaptation.

Changes	Adaptive/Coping strategies	Supporting quotes	
Variations of rainfall times	• Change planting times • Only plant once per year	 Doña María AcojCuxum "Cuando está en tiempo de estar jiloteando la milpa, y ya no llega el agua, allí se seca y ya no podemos cosechar nada."  Doña Clara Juárez Morales " (...) Porque es mucha lluvia, entonces la semilla como es al aire libre, no tiene, entonces se pudre la semilla. (...) Entonces por eso prefiero sembrar en los meses de verano."	"When the cornfield is at the stage of forming ears, and no more water comes, it dries out, and then we cannot harvest anything." "(...) Because there is so much rain, and since the seed is out in the open air, it ends up rotting. (...) That is why I prefer to plant during the summer months."
No water access for domestic use	• Water reservoirs • Scheduled water access	 María Dominga AcojCuxum "(Después de la lluvia) sí, viene agua sucia, pero yo tengo ese tambo ahí. De por sí, ahí deajo llenada mi agua para tomar".  Doña Zoila Coloch Ixpatá "Es porturnos, empieza el sector arriba, es portres días o dos días y medio. Nosotros (la comunidad) lo vamos cambiando. Hemos acordado."	"(After the rain), yes, dirty water comes in, but I have that barrel there. I usually keep my drinking water stored there." "It is done in shifts. The upper sector starts, and it lasts for three days or two and a half. We (the community) take turns. We have agreed on it."
No water for crop irrigation	• Sprinkler irrigation • Lined retention ponds	 Don Tomás AcojCahuec "Ahorita hay agua, pues entonces no lo regamos. La milpa lo hace solo. Ya en verano, sí, porque ahí necesita el agua, regamos con mariposa."	"Right now, there is water, so we do not irrigate it. The cornfield takes care of itself. In summer, yes, because that is when it needs water, we irrigate with a sprinkler."
Low fertility levels in soil	• Lombricompost • Biochar • Mountain microorganisms	 Don Mario Rene Gonzáles Cordova "Yo sí incorporo (MM) porque eso es lo que hace que le de más vida a la planta. Son beneficiosos para el suelo (...). El año pasado, fui a recolectar MM y traje tres costales, le incorporé al resto de abono, lo mezclé, entonces esa vez me duró la cosecha hasta ocho meses, porque la planta no moría, ahí se mantenía. Ahora incluso veo en los surcos y le pongo un palito húmedo y tiene microorganismos todavía (donde se plantó)."	"I do incorporate MM because that is what gives more life to the plant. The are beneficial for the soil (...). Last year, I went to collect MM and brought back three sacks. I added it to the rest of the fertilizer and mixed it, and that time the harvest lasted up to eight months, because the plant did not die, it remained healthy. Now I can even see it in the planting rows, and when I put a damp stick in, there is still microorganisms (where it was planted)."

Changes	Adaptive/Coping strategies	Supporting quotes	
Decline on the amount of traditional products harvested (e.g., maize, beans, and fruits)	• Eat some of their fish production • Substitution of goods to sell • Family sharing	 Doña Irma  Yolanda Torres	"El año pasado perdí mis cosechas de tomates, casi todo se perdió. No pude vender mi tomate, no pude ganar mi inversión, vendí solo cuatro cajas de tomate. Al tomate le afecta lo que es el cambio climático. (...) Tuve que reemplazar por hierbas y vendí hierbas." <i>"Last year, I lost my tomato crops, almost everything was lost. I could not sell anymore, I could not recover my investment; I sold only four crates of tomatoes. Tomatoes are affected by climate change (...) I had to replace them with herbs, and I sold herbs."</i>
Lack of financial means	• Sell fish to earn money to buy other products • Sell tomatoes and edible herbs to earn money to buy other products • Become security agents to support their families	 Suarlin Cortez Canahui  Doña Zoila Coloch Ixpatá	"Los tenemos seis meses dentro del estanque, luego los clasificamos y los vendemos según peso y tamaño." <i>"We keep them in the pond for six months, then we classify them and sell them according to weight and size."</i> "Vendo leche y queso. Lo que hago es vender queso cada dos días, con ese dinero compro el concentrado, sal mineral, vitaminas, lazos. (...) Compramos frijol." <i>"I sell milk and cheese. What I do is sell cheese every two days, with that money I buy concentrated feed, mineral salt, vitamins, ropes. (...) We buy beans."</i>
Plagues in crops	• Mountain microorganisms + chicken manure • Greenhouse/casa malla and drip irrigation	 Suarlin Cortez Canahui  Doña María Santos Ixpatá	"MM se usan para combatir plagas en cultivos y también malos olores en los gallineros." <i>"They are used to fight plagues in crops, and also to eliminate bad odors in the chicken coops."</i> "Ah el tomate sí se puede sembrar, porque está tapado donde está así como éste, ahí no entra la lluvia. Si no tuviera (greenhouse), ahí sí se arruinaría." <i>"Oh tomatoes can be planted, because they are covered, like this one, rain does not get in there."</i>
Death of chicken	• Replace chicken with other meats (e.g., fish or pork) • Feed the chicken with Mountain microorganisms before they die • Vaccines • Purchase of chicken	 María Dominga AcojCuxum  Don Alfredo Cortez Galiego	"Por el 'accidente' que pasó hace como un mes y medio, se llevó como 60 pollitos, 40 gallinas ponedoras y chuntos se llevó como tres. Eso fue ahorita en junio." <i>"Due to the 'accident' that just happened about a month and a half ago, 60 chicks, 40 laying hens, and about three turkeys were gone. That happened just now in June."</i> "Más es darle una vida más ecológica, más orgánica, le doy microorganismos de montaña. (...) Es más natural entonces se ponen más fuerte su sistema inmune, están más nutridos y tienen defensas. Les da la peste, pero no les pega como cuando no tienen defensas." <i>"It is more about giving them a more ecological, more organic life; I give them mountain microorganisms. (...) It is more natural, so their immune system gets stronger, they are better nourished, and they have defenses. The 'pest' comes but it does not affect them like it would if they had no defenses."</i>
Less forage grass for livestock	• Drought-resistant grass	 Doña Zoila Coloch Ixpatá	"(En una sequía), el Brizantha aguanta más" <i>"(During drought), Brizantha tolerates more."</i>

Conclusion

Xesiguán is being impacted by climate change and farmers are already working to adapt to these changes. In Xesiguán, agroecology has become a preferred response to adapt to climate change. Farmers want to go back to agroecological practices, as their ancestors did in the past. They have successfully

implemented MM in their farming activities, and it has helped improve their soil health, the metabolism of the plants and even boost their animal's immune systems. Therefore, Xesiguán farmers are convinced that they want to follow a path where they can embrace their past to inform their future.

“Vale la pena regresar poco a poco (a nuestras prácticas agroecológicas)”

“It’s worth going back (to our agroecological practices)

little by little”

- Alfredo Cortéz Galiego.



To support adaptation, it is important to listen to the voices of the people who are the forefront of climate change, and who can inform better the adaptation processes.

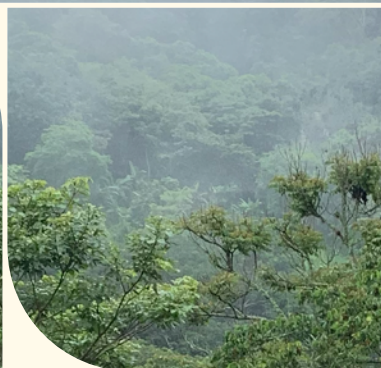
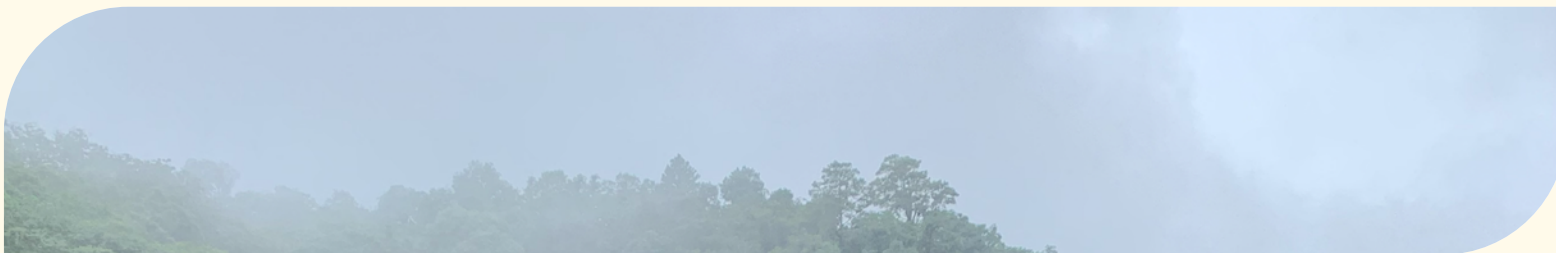
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