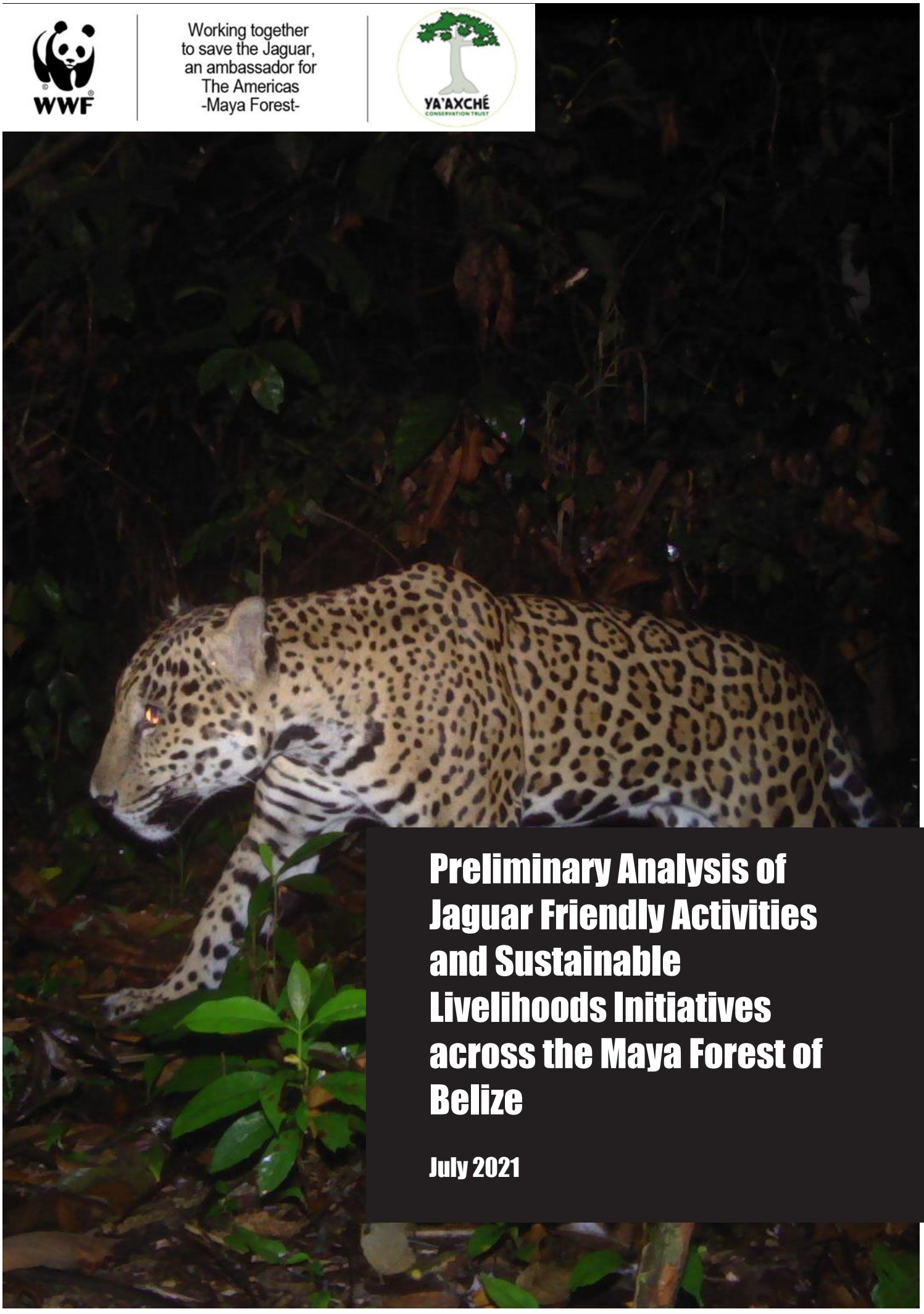
Working together
to save the Jaguar,
an ambassador for
The Americas
-Maya Forest-



Preliminary Analysis of Jaguar Friendly Activities and Sustainable Livelihoods Initiatives across the Maya Forest of Belize

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Introduction

This document provides a review of documents relating to jaguar conservation and management in Belize along with the sustainable livelihood initiatives implemented across Belize. These include review of peer-reviewed publications, national reports from government entities and non-governmental organizations, news media reports, and direct information gathered from key stakeholders in the agricultural, environmental, and tourism sectors. It also highlights the strengths, challenges, and opportunities to strengthen jaguar conservation efforts and bolster sustainable livelihood initiatives, all of which will be integrated into an action plan to promote jaguar-friendly activities and sustainable livelihood initiatives across the Maya Forest of Belize

Figure 1. A landscape view of the Maya Mountain North Forest Reserve, a key biodiversity area for Belize.

Belize is a relatively small country with a diverse landscape, embedded with a diversity of plants and animals. The elusive jaguar (*Panthera onca*) is a culturally and economically iconic species for our country (Dobbins et al., 2018; Kay et al., 2015; Steinberg, 2016). Jaguar also plays an important role in controlling prey species populations in the forest food web and helps maintain a healthy ecosystem (Brossard & Pritz, 2013; Kay et al., 2015; Sanderson et al., 2000; Zeller et al., 2013). Belize has emerged as an international leader in jaguar conservation through the designation of several protected areas and by strengthening conservation laws (Steinberg, 2016). Particularly important for jaguar conservation as it is a corridor between populations in Guatemala and Mexico and the rest of Central America (Dobbins et al., 2018).

Jaguars are an active target for conservation initiatives through the regional Panthera initiative, linked to the establishment of biological corridors in Belize (Kay et al., 2015; MFFSD, 2014). Three biological corridors in Belize namely the Southern Biological Corridor, the Maya Forest Corridor, and the North-eastern Biological Corridor connect with protected areas, increasing the size of the Selva Maya (Figueroa, 2013). The Selva Maya, also called the Maya Forest, is a unique tri-national geographic region between Belize, Guatemala, and Mexico that contains the largest remains of intact forest in Central America (Figueroa, 2013; Kelly, 2003) and subsequently forming an important part of the Mesoamerican Biological Corridor. For Belize, the presence of top predators such as jaguars suggests that the trophic structure is still mostly intact, with viable populations of prey species (Walker & Walker, 2009).

Threatened by habitat loss and fragmentation resulting from human development and increasing agricultural expansion coupled with overhunting of wild prey and the human-jaguar conflict (Figueroa, 2013; Foster, Harmsen, & Doncaster, 2010; Hernández-Aguilar et al., 2017). Consequently, jaguar conservation across Belize is crucial as it helps safeguard the jaguar population without jeopardizing the population viability. Protecting forest connectivity and promoting sustainable livelihood initiatives across the landscape of Belize can also contribute to the continued survival of the species while supporting livelihoods of communities through food security and income generation.

Direct Threat

Jaguars require extensive tracts of natural vegetation, as well as a healthy prey base, and is, therefore, a logical keystone species target for active conservation initiatives in Belize (Kay et al., 2015). The increased loss of forest and livestock depredation by jaguars arise conflict and poaching; coupled with that, lack of food from overhunting of their prey results in jaguar mortalities in Belize.

Habitat Loss from Deforestation

The increase in agricultural and residential development across Belize has contributed to an increase in deforestation and subsequent fragmentation (MFFSD, 2014; Young, 2008). Over the last decade, large-scale agriculture inclusive of citrus, bananas, sugar cane and, more recently, large-scale aquaculture inclusive of shrimp and tilapia farming have escalated at the expense of the forests (Young, 2008). Coupled with illegal logging, slash and burn agriculture, and increasing incursion of illegal Guatemalan immigrants in Belize forest and protected areas for farming, hunting and harvesting non-timber forest products (MFFSD, 2014; The San Pedro Sun, 2014). This jeopardizes the valuable biodiversity of Belize; most notably, the destruction of habitat threatens already struggling jaguar populations (Morrow, 2020). Although the North-eastern Biological Corridor provides the link between protected areas to provide safe passage for larger mammals such as jaguars and pumas to move freely, anthropogenic factors such as expanding agricultural lands and other infrastructure development rampant deforestation around this area (Dasgupta, 2018; Meerman, 2000). In addition, the Maya Forest Corridor connects the two largest forest blocks, which are separated by human developments, and the Western Highway in central Belize (Figueroa, 2013). Highways impede the movement of jaguars and other wildlife, and in most cases, it results in roadkill. Moreover, the Mennonite community are the largest farmers producing agricultural commodities; however, it is associated with the highest rates of land clearance, and land degradation in northern and western part of Belize (MFFSD, 2014). As for the Southern Biological Corridor, human development and agricultural expansion are the main drivers of deforestation and threatens the crucial link between the Maya Mountains and coastal lowland forests (Ruscalleda & Smith, 2016; Ya'axché Conservation Trust, 2014). Cattle farming is also increasing in footprint in southern Belize and is also prevalent in western Belize, being one of the current drivers behind deforestation, resulting in large areas of cleared lands and degraded soils (MAFFESD, 2016).

Overhunting of Wild Prey

The intensification of game hunting and lethal control of predators would also threaten population persistence (Foster et al., 2020). The jaguar diet mainly consists of armadillos, pacas, and peccaries (Foster, Harmsen, Valdes, et al., 2010) as those same prey species are frequently hunted for human consumption. Foster et al., (2016) documented the share of wild meat among people and predators in Belize indicated rural communities in the Toledo District have a high consumption rate when compared with other districts across Belize. This creates direct competition for the same food source that often leads jaguars to wander long distances in search of food and at times encounter opportunistic prey such as livestock, which leads to conflict.

Human-Jaguar Conflict

Jaguars are more transient where the landscape is fragmented with settlements and agriculture than in contiguous forests (Foster et al., 2020). Foster (2008) documented that human-induced mortality of jaguars outside the protected forest was mainly associated with livestock predation. Many of the farms and villages border forests, and livestock and domestic animals are seen as opportunistic prey for jaguars. Over 60 cats were reported killed by farmers between 2002 and 2004 as a result of conflicts with livestock across Belize (Foster, 2008). In most cases, conflicts are perceived in the form of livestock depredation in which farmers use lethal control to retaliate against jaguars as a last resort, whilst this increases the jaguar mortality rate. The lethal method of eradicating the threat is hindering conservation effort as well as biodiversity conservation of the jaguar. Often the unreported human-jaguar conflict also poses a challenge as it prevents relevant authorities from responding to provide technical support or advice on mitigation strategies to reduce predatory attacks. In addition, farms with poor livestock husbandry and management are vulnerable to livestock depredation (Quigley et al., 2015). Lack of infrastructure and economic capacity for the implementation of anti-predation strategies results in poor livestock security (Foster, 2018).

Wildlife Trafficking

Illegal Wildlife Trade has received very little attention in Belize; however, studies and anecdotal information indicate that the trade Belize is aligning with the global trend as it is expanding (WCS, 2020). The increase in poaching of jaguars for illegal trafficking is exacerbating across its range in Latin American (UNEP, 2018) although this is not prominent in Belize. In the past, a dozen of illegal jaguar parts such as pelts, teeth, and skulls have been confiscated by the Belize Forest Department (Root, 2019). Perhaps jaguar parts sold locally are the result of the jaguars killed in retaliation of conflicts with livestock. A few cases surfaced in the news media due to unreported cases and operations persist in the black market. For example, in Caledonia Village of Northern Belize, a hunter was on a hunting trip for game meat when he encountered an adult male jaguar, which has led to the jaguar being imprudently prosecuted and skinned for its pelt (7 News Belize, 2012). In Central Belize, two jaguars were shot and found

in the Belize City canal with one jaguar decapitated (News 5, 2018). This disturbing news alarmed conservationists and Belizeans across Belize. This has led to a reward of $ 10,000 BZ for anyone who provides information that leads to the arrest and conviction of the perpetrator, unfortunately, no one was detained. According to the Forest Department, this heinous act could be due to human-jaguar conflict where jaguar attacks livestock that triggered farmers to retaliate or it could be illegal poaching since there has been an increase in demand for jaguar parts (News 5, 2018). A jaguar and an ocelot succumbed to the same fate of decapitation in the Toledo District (Ambergris Today, 2019) as this was reported to be part of an illegal poaching activities of wildcats.

Legal Framework

Belize like any other country is governed by robust legislation that ensures the protection and management of its natural resources. Relevant legislation such as the Forest Act, the National Protected Areas System Act, and the Wildlife Protection Act is there to impact jaguar conservation as it pertains to the management of protected areas, forest resources, and wildlife. Under the Wildlife Protection Act, it set out protection by regulating hunting and commercial dealing of wildlife. Jaguars are protected under the Wildlife Protection Act, as stipulated it is illegal to hunt and kill jaguar for sport, leisure, and consumption. However, it has provisions that offer for the jaguar to be legally shot when life and property are at stake (Wildlife Protection Act, 2000). Frequently, these provisions have been applied by farmers and others to justify the hunting and killing of jaguars (Figueroa, 2013) coupled with limited resources for effective enforcement and surveillance, ultimately hindering the conservation effort (MFFSD, 2014). Belize is also a signatory to international conventions such as the Convention on International Trade of Endangered Species (CITES) and Convention on Biological Diversity (CBD) that mutually seek to pursue a common strategy in ensuring the country's actions are in line with international objectives and targets to support biodiversity conservation. Similarly, Belize is a member of the International Union for Conservation of Nature (IUCN) and the jaguar is listed as a near-threatened species under the IUCN Red List of Threatened Species.

Social and Ecological Research Implications

Numerous studies associated with different aspects of jaguar ecology have been conducted in Belize (Dobbins et al., 2018; Doherty, 2005; Figueroa, 2013; Foster, Harmsen, & Doncaster, 2010; Harmsen et al., 2020; Harvey et al., 2017; Kelly, 2003; Rabinowitz & Nottingham, 1986). Few of these studies were very instrumental in management intervention and policies towards jaguar conservation in Belize. For example, the first study on jaguar research conducted in Belize was in the early 1980s (Rabinowitz & Nottingham, 1986) that led to the establishment of the world's first jaguar preserve in Belize (Rabinowitz, 2000). Most studies were conducted to better understand the importance of biological corridors for jaguar movement pattern, distribution, status, diet, and habitat use (Figueroa, 2013; Foster et al., 2016, 2020; Harmsen et al., 2010, 2011). It has contributed to the inclusion of biological corridors within the National Protected Areas System Plan of Belize to ensure interconnectivity among protected areas complex both for national and regional importance (Meerman & Wilson, 2005; MFFSD, 2015). Connectivity among jaguar populations will ensure natural gene flow and the long-term survival of the species throughout its range (Menchaca et al., 2019).

The advent of camera traps and radiometric collars presents a new paradigm for monitoring cryptic species such as jaguars (Harmsen et al., 2010, 2020) as well as the use of physical evidence such as scats, footprints, and scratch marks which helps in jaguar research (Foster, Harmsen, Valdes, et al., 2010). In addition, the deployment of camera traps can assist researchers to work with farmers that might be negatively affected by jaguar predation on livestock (Quigley et al., 2015). At times, farmers blamed the jaguar for attacks on livestock without having tangible evidence, thus resulting in jaguar mortality. With the camera traps, it can document the jaguar responsible for such an attack due to the jaguar's unique spot pattern, thus reducing the retaliatory killing of the jaguar not responsible in such conflict. Similarly, studies with regards to the perception of communities on human-wildlife conflict have been documented in Belize (Foster, 2018; Steinberg, 2016; Waters, 2015; Waters et al., 2006). Most of this social research focused on understanding the perception of communities towards jaguar conservation and its associated conflict. A few studies are available in promoting jaguar conflict mitigation strategies to reduce jaguar predation on livestock (Carlisle & Lopez, 2019; Hernández-Aguilar et al., 2017; Quigley et al., 2015).

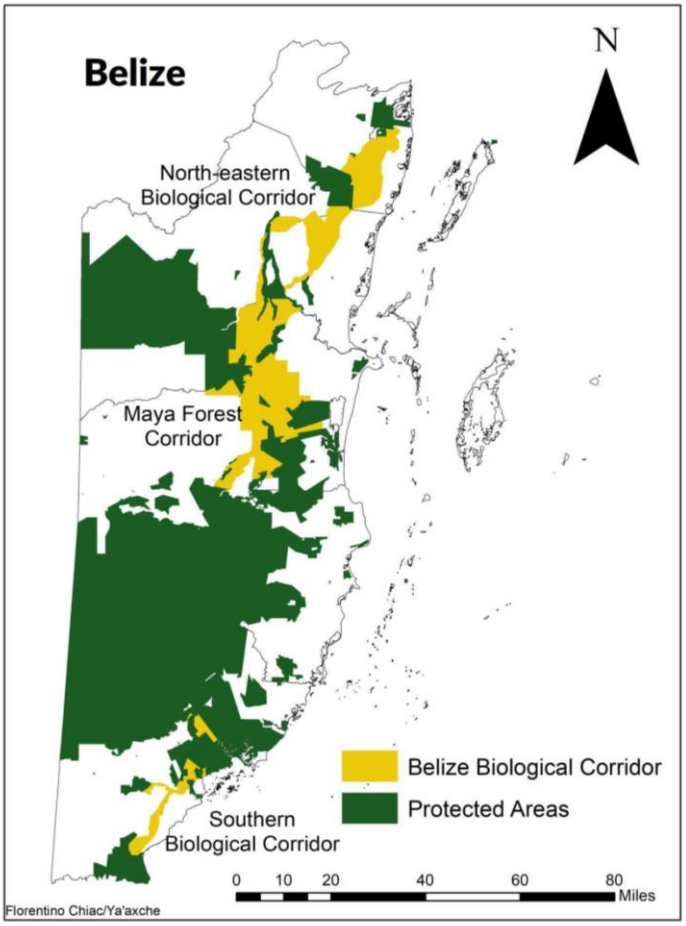
There was an investigation on observations and preliminary testing of jaguar depredation reduction techniques in and between core jaguar populations (Quigley et al., 2015). For this study, multiple testing scenarios and the result were gathered throughout Latin America including Belize in the agricultural landscape across protected areas to reduce depredation of livestock and prevent the lethal control of jaguars. In this study, several methods were reviewed on improving livestock husbandry and management, where mitigation strategies recommended, included electric fencing, night enclosures, designs for newborn holding pens, the use of guard animals, and partial herd immersion of creole cattle. The success of this piloted test for depredation solution showed effective results to reduce cattle depredation. To complement the research, a case study conducted by Carlisle & Lopez (2019) investigated the coexistence of cattle farmers and jaguars within the Southern Biological Corridor and has also evaluated the Ya'axché Conservation Trust Human-Jaguar Conflict Program. The case study assessed the effectiveness of the mitigation strategies that have been piloted across nine demonstration farms

to reduce livestock depredation and the retaliatory killing of jaguars. Mitigation strategies were categorized as lights, alarms, and fencing. The study concluded that the solar night predator deterrent (foxlight) was the most effective tool followed by catch pen/corral, secure fencing, and integration of donkey in the pasture to deter jaguars around the farms. Another component was understanding the perception of cattle farmers to see whether there is a change in behavior and attitude towards the jaguars. After the pilot project of the mitigation strategies, farmers were thrilled with the deployment of these mitigation tools; they haven't lost any calves from jaguar attacks. The study concluded that there is a change in farmer's attitudes and behavior towards jaguars after technical support was provided. Acceptance of coexistence with jaguars by farmers will allow jaguars to continue to survive in the fragmented landscape while livelihoods are secured with mitigation strategies implemented.

Action taken

National Protected Areas System and Biological Corridors of Belize

Belize enacted many environmental laws and policies aimed at the preservation and protection of Belize's natural resources and biological diversity. The National Protected Areas System Plan (NPASP) incorporates protected areas more effectively to the surrounding landscape as it contributes to improving the conservation of biological diversity and maintaining a healthy ecosystem. It also focuses on maximizing the social, cultural, and economic wellbeing of Belizeans both for local and national development. Additionally, the National Protected Areas System Act aims to promote long-term conservation, management, and sustainable use of Belize's protected areas, but it also seeks to ensure maintenance of genetic diversity and that of species and habitats (FAO, 2015). The Belize Forest Department is the entity responsible to provide critical functions related to site-based management of terrestrial protected areas and the overall administration structure of protected areas at the system level. The non-governmental organization or other organizations enter into an agreement with the Belize Forest Department for co-management of a specific protected area. The national protected areas system of Belize represents approximately 36% of Belize's terrestrial areas (MFFSD, 2015) and the conservation of jaguars is tied to protected areas largely due to their success in undisturbed areas by supporting a wild prey base and often providing refuge from direct persecution by people. (Morrow, 2020; Quigley et. al 2015). In addition, the inclusion of the three biological corridors of Belize in the NPASP is crucial to maintain forest connectivity between protected areas and the rest of the landscape. The connectivity is critical for the maintenance of full species diversity and ecosystem services, preventing genetic isolation of populations and allowing migration of species and ecosystems over time (MFFSD, 2015). Consequently, the maintenance of the large forest nodes and the establishment of biological corridors are the most effective strategies Belize has for maintaining its jaguar population (Walker & Walker, 2013).



Map 1. National protected areas system and the biological corridors within the Maya Forest of Belize.

Sustainable Agriculture and Agroforestry

Belize's natural resource and diverse landscapes provide critical habitat function to threatened species both for national and regional importance while it supports the agriculture sector of the country. The agriculture sector is the backbone of the national economy of Belize with citrus, banana, sugar cane, cattle, and farmed shrimp being the main traditional commodities. The National Agriculture and Food Policy of Belize's main role is to provide an environment that is conducive to increase production and productivity while promoting investment in a sustainable manner and encouraging the private sector to involve in agribusiness enterprises. It is based upon five pillars that provide a platform to guide the development and transformation of the Agriculture and Food Sector into economic growth and development in the country. However, there is a need to enforce the policy to drive the agriculture activity towards sustainable farming practices that would ensure environmental sustainability. As agriculture continues to expand, the forest cover for Belize continues to shrink, reducing habitat for endangered species and contributing to climate change. For many years, farmers, particularly the Mayas in Belize have been using slash and burn agriculture to produce fertile soil for their crops, whereas large-scale farmers utilized mechanized agriculture. However, these types of cultivation can contribute to deforestation and land

degradation, which can subsequently result in a number of serious environmental crises such as loss of biodiversity and ecosystem services. Agroforestry has been identified as a more sustainable method of farming to mitigate climate change and protect biodiversity. Agroforestry systems can help provide a wide range of environmental services not limited to improving soil fertility, restoring degraded lands, improving water conservation, and preventing soil erosion. **It also helps with food security in building resilient livelihoods and creating a transition zone which helps reconnect people, agriculture, and the environment, thus creating a more sustainable landscape.**

Belize now has a National Agroforestry Policy that aims to promote silvo-agricultural, silvopastoral, and agro-silvopastoral systems, which will increase the welfare and income of Belizeans in the national agricultural, forestry, and environmental sectors. Having this policy will allow the country to advance in the fulfilment of the Sustainable Development Goals, as well as contribute to the adaptation and reduction of greenhouse gas emissions at the national scale. Across the country of Belize, a few of the non-governmental organizations such as Friends for Conservation and Development and Ya'axché Conservation Trust are encouraging farmers to implement sustainable farming practices that will lead to a better quality of life in the rural areas and contribute to a green economy. Moreover, private estates such as Gallon Jug and Belize Foundation for Research and Education have been promoting agritourism as a sustainable model to provide employment opportunities and generate revenues while maintaining the integrity of the forest.

Friends for Conservation and Development (FCD) is a non-governmental organization based in the Cayo District with an assertive management presence in the Chiquibul Forest, representing a huge portion of the central part of the Maya Forest of Belize. Besides protected area management, FCD continues to provide extension services to the farmers promoting agro-ecological practices near and inside the Vaca Forest Reserve. Since then, 22 farmers have been operating outside and inside of the forest reserve which later established the Friends of the Vaca Forest Reserve with an interest in becoming stewards of the forest reserve. FCD developed a Landscape Management Strategy aimed at incorporating local community members to participate in the restoration, protection, and production of the forest reserve. Under this strategy, FCD was able to secure funding to promote landscape management in the Vaca Forest Reserve through community development and support. It helps strengthen apiculture inside and near the forest reserve, cultivation of organically grown vegetables as well as reforestation of degraded lands in the forest reserve. In addition, FCD provides extension service to the Cayo Quality Cooperative for beekeeping and has been building capacities of the farmers to become a model of stewardship in the protection of forest reserves through local participation. Promoting these agroecological practices will not only generate income and food security for farmers but also motivate them to become stewards of the forest reserve.

Ya'axché Conservation Trust (Ya'axché) is a Belizean non-governmental organization geared towards promoting protected area management while supporting human development through community outreach and livelihoods in the Maya Golden Landscape (MGL) of Toledo District. The MGL is a mosaic landscape comprising protected areas, communal, private, and state lands which is crucial to ensure the connectivity between the Maya Mountain Massif and the southern coastal plains. The connectivity within the landscape forms an important part of the Southern Biological Corridor, extending the size of the Selva Maya Forest as part of the Mesoamerican Biological Corridor. Within the MGL, Ya'axché owned and managed the Golden Stream Corridor Preserve and comanages Bladen Nature Reserve and Maya Mountain North Forest Reserve. Over the past 20 years, Ya'axché has been working on educating and training farmers to help them move away from slash and burn agriculture and towards more climate-smart agriculture. Farmers realize that slash and burn agriculture is not environmentally friendly and needs to transition to promote sustainable farming practices. Ya'axché was able to provide technical assistance to farmers through the donation of seeds, inga seedlings, cacao trees, and equipment as well as extension services to support the work. Ya'axché have supported over 150 farmers and their families to implement climate-smart agriculture such as cacao agroforestry, inga alley cropping, slash and mulch as well as apiculture as shown below in Figure 2. This will not only reduce deforestation but protect biodiversity and ecosystem services as well as enhance the livelihoods of farmers through income generation and food security. Consequently, these practices contribute to jaguar habitat conservation and allow for jaguars to continue to survive in the fragmented landscape in the southern part of the Maya Forest of Belize. To encourage farmers to continue implementing this climate-smart agriculture, Ya'axché hosts an annual event called **Ya'axché Farmers Expo** held at the beginning of the dry season to raise awareness about escaped agriculture fires which can be detrimental to wildlife, forest, people, and property. The important aspect of the event is the recognition of the farmers that are implementing climate-smart agriculture in the landscape. Ya'axché's extension officers assessed the farms of the farmers involved in implementing the practices to determine which farms have excelled as top farmers of the year. Selected farmers are awarded financial and technical support to continue implementing these environmentally friendly practices on their farms. Ya'axché is one of the leading organizations striving to strike a balance in harmony between nature and human development for the benefit of both.

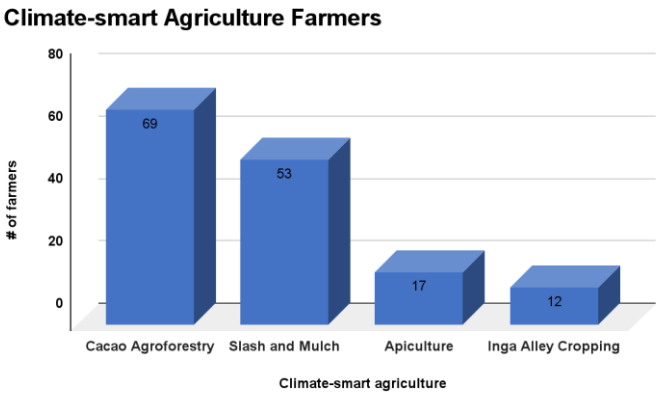


Figure 2. The number of farmers actively involved in implementing climate-smart agriculture across the MGL.

Cacao in Belize

Cacao is a cultural crop cultivated mostly by Mayan farmers of the Toledo District. Farmers utilize this practice as a cash crop for income generation to enhance livelihoods and cacao production is concentrated in the Toledo District. Cacao producers can also be found in Stann Creek and the Cayo Districts. Recently, there has been an interest in the development of a cacao plantation by Gallon Jug Estates in the Orange Walk District. The traditional methods of the Mayas in planting, harvesting, and processing organic cacao are kept alive today as a way to preserve the rich flavors and aroma of the cacao. Cultivation of cacao in an agroforestry system without the application of inorganic fertilizers and pesticides is the primary reason why investors are compelled to purchase Belize's organic cacao. Growing cacao trees in an agroforestry system yield high-quality products due to the natural nutrients and minerals provided by the forest. Additionally, three varieties of cacao are produced in Belize including the criollo, trinitario, and forastero. Both non-grafted and grafted cacao trees are cultivated in Belize, although grafting cacao trees is used as a strategy to improve the quality of the pods, the tree's productivity levels, and its disease resistance as well as reaching early maturity period for production.

The cacao industry is a relatively young industry presently constrained by low production and high fixed cost and has resulted in minimal investment into the sector from large stakeholders. National production is currently estimated at 100 tonnes per annum, which is insufficient to attract industrial chocolate manufacturers and large-scale foreign investment to the sector (CAIB, n.d.). However, Belize has become known for its high-quality cocoa and local enterprises promote local value-added of the product to utilize in the domestic tourism market. Farmers and their families have started adding value to their cacao beans, including cacao butter, chocolate, soap, wine, compost, and tourism-related products (International Development Consultants Ltd., 2015). In addition, the growing chocolate industry is creating significant changes in the market dynamics of Belize's cacao sector.

The Cacao Agroforestry Institute of Belize was established in 2018 with a mission of getting the cacao industry in Belize to scale in a sustainable manner. The institution sees a need to scale up the cacao industry in areas of research opportunities, field testing, data collection, and yield analyses which will establish best practices for cacao cultivation. Focusing on scaling up the cacao industry can provide an opportunity to remediate abandoned citrus plantations affected by citrus diseases by planting cacao and to reforest degraded lands by planting hardwood species with cacao in an agroforestry system. Venturing into the expansion of cacao agroforestry are promising models for enhancing production and diversifying income while preserving the biodiversity and ecosystem services of Belize. Cacao agroforestry acts as a carbon sink and can increase forest cover contributing to the extent of the Maya Forest of Belize. Studies have documented that cacao agroforestry still maintains high aboveground and underground biodiversity equivalent to an undisturbed forest, thus utilized as a sustainable land use strategy (McQueen & Treonis, 2020).

Figure 3 below illustrates Belize's cacao production levels for the past twenty (20) years (2000-2001). It indicates that the highest level of cacao production in Belize was in the year 2017 and reached its highest production level at 244 metric tons. Belize cacao production has been slowly increasing and fluctuation in production over the years varies, perhaps due to escape agriculture fires which destroyed crops and Molinia disease which has disrupted the cacao production in the past. This highlights the importance of encouraging the practice of cacao-based agroforestry to become resistant to pests and disease. As new cacao producers seek to reinvest and expand production, there will be a positive outlook as the year progresses, ultimately increasing production level. It will serve as an entry point to the international niche market to attract investors to purchase cacao beans from Belize.

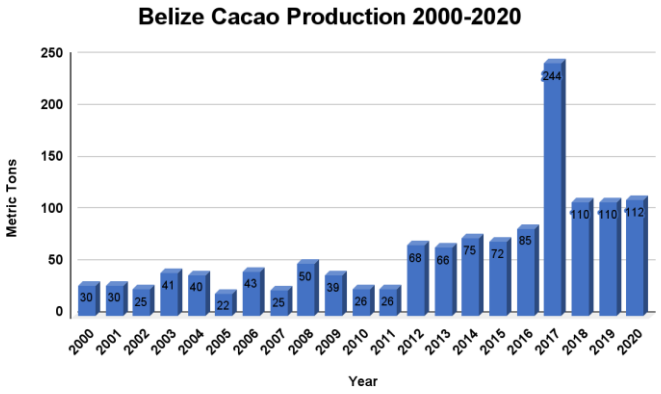


Figure 3. Cacao production levels for Belize from the period of 2000 to 2020. (Source: Ministry of Agriculture, Food Security and Enterprise)

Ya'axché Cacao-based Agroforestry

Cacao-based agroforestry is one of the climate-smart agricultural practices promoted by Ya'axché and implemented by the farmers in the southern part of the Maya Forest of Belize. This alternative farming still remains the most outstanding livelihood initiative to generate additional income for rural communities. Ya'axché was very instrumental in the establishment of Belize's first cacao agroforestry concession in the Maya Mountain North Forest Reserve (MMNFR). The Trio Farmers Cacao Growers Limited inclusive of thirty-one Mayan farmers are the direct beneficiaries of this concession model contributing to enhancing livelihoods through food security and income generation while becoming stewards of the forest reserve. Farmers are already reaping the benefits from the agroforestry systems as the cacao production continues to increase as the year progresses, shown below in Figure 5. The cacao concession model can continue to serve as a long-term solution to improve forest health and conserving biodiversity while sustaining livelihoods. Since 2016, Ya'axché has been consistently monitoring wildlife presence via camera traps within cacao agroforestry farms buffering the protected areas in the MGL. Wildlife monitoring helps understand how farmscapes provide connectivity as corridors and habitats for wildlife, thus contributing to biodiversity conservation both for national and regional importance. The monitoring effort has shown substantial evidence that wildlife such as the majestic jaguar inhabit the landscape, depicted below in Figure 4. It is therefore imperative for the continuation of work effort with agroforestry farmers, as their farms maintain habitat connectivity and provide a haven for wildlife while sustaining livelihoods. Strengthening natural resource management and biodiversity conservation of the

MMNFR is critical as one of the key biodiversity areas in the Maya Forest of Belize. Having legal access for indigenous people to utilize the forest reserve in a sustainable manner is a model that can be replicated in other forest reserves across Belize.

Ya'axché is currently working with sixty-nine (69) farmers from ten (10) communities who have cacao grown in an agroforestry system with thirty-one (31) farmers cultivating cacao in the MMNFR. Under the Ya'axché Community and Outreach Livelihoods Program, extension officers provide services to educate and train farmers to plan and design their farms, in pest and shade management as well as provide technical assistance which is project-based through the donation of cacao seedlings, cacao seeds, and germination bags. Figure 5 below indicates that over the past four years, there has been a steady increase in the production of cacao as the year progresses, whilst income generated continues to increase yearly as shown below in Table 1. An increase in cacao productivity is attributed to effective farm management supported by the agroforestry system which is also supporting a diverse range of wildlife. The foreseeable benefit of the cacao production will continue to increase as the year goes by, and of course determined and dependent on farm management practices.

Figure 4. A female jaguar detected by a motion sensor camera trap in the MMNFR cacao agroforestry concession.

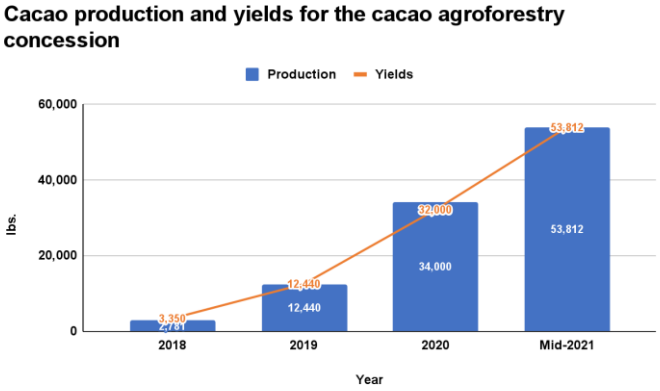


Figure 5. Cacao production and yields in the Maya Mountain North Forest Reserve.

Table 1. Income generated from cacao production in the Maya Mountain North Forest Reserve Concession.

Year	Cacao Yields	Unit Price	Total Cost
2018	3,350	BZ $1.00	BZ $3,350
2019	12,440	BZ $1.00	BZ $12,440
2020	32,000	BZ $1.00	BZ $32,000
Mid-2021	53,812	BZ $1.00	BZ $53,812

Belize Foundation for Research and Environmental Education

Belize Foundation for Research and Environmental Education (BFREE) is a conservation organization based in Toledo District which owns and manages 1,153 acres of the private protected area situated in the foothills of the Maya Mountains. One of BFREE's research is the cacao agroforestry research program, which aims to integrate scientific research on growing wild criollo cacao plantations under tropical forests. The idea behind this research was to measure and compare ecosystem functioning and ecosystem services across a continuum of tropical forest from high to low shade cacao plantations to determine the best scenarios that will allow optimizing cacao production while optimizing biodiversity and ecosystem services (BFREE, n.d.). Pioneering the propagation of wild criollo cacao has foreseeable economic, social and environmental benefits as it is considered the wild ancient heirloom fine flavor cocoa. Considering its environmental benefit, BFREE has over 15 acres of cocoa growing in an agroforestry system, where wildlife such as jaguars, tapirs, howler monkeys, harpy eagles, and scarlet macaws make their home (BFREE, n.d.). Through this cacao agroforestry research program, the Belize Cacao Agroforestry Handbook was developed intended to guide farmers through basic land preparation, nursery management, planting maintenance, harvest, and post-harvest. The manual is a simple guide inclusive of illustrations for easy comprehension to farmers interested in promoting organic cacao-based agroforestry that will contribute to habitat restoration for wildlife.

Cacao Market

Two companies namely the Maya Mountain Cacao and the Toledo Cacao Growers Association in the Toledo District purchase wet cacao beans from farmers in the Toledo and Stann Creek District. The companies facilitate the sourcing of the cacao beans from the farmers, subsequently having a centralized processing facility where the fermenting, drying, and storing of cacao beans occurs respectively. Both companies identify the niche market at the international level for cacao beans and export to the United States and European market. At a national level, many chocolatiers such as the Belize Chocolate Company Limited, Che'il Chocolate, and Ixcacao purchase fresh cacao beans from the farmers to make chocolate and other value-added products for the domestic tourism market.

Maya Mountain Cacao Limited (MMC)

MMC is a for-profit organization based in the Toledo District with the aim of promoting reforestation and encouraging organic and sustainable agroforestry. Since its inception in 2010, MMC set Belize on a craft of chocolate map as a pioneer in the centralized fermenter social enterprise model, and the first exporter in the country to produce high quality, centrally fermented cacao for the

United States craft chocolate market (Uncommon Cacao, 2019). The MMC is one of the primary buyers of cacao in Belize and sources premium wet cacao beans from smallholder Belizean farmers for one dollar ($1.00) per pound. This is contributing to improving the farmers' livelihoods through income generation, and ultimately driving economic growth. In addition, the cultivation of cacao significantly contributes to reforestation efforts and promoting sustainable organic farming practices in southern Belize. MMC works with 350+ certified organic smallholder cacao farming families in the Toledo and South Stann Creek districts. Wet cacao beans purchased by MMC are deposited in a centralized post-harvest facility that undergoes the process of fermentation, drying, sorting, packaging and storing of beans. The fermentation and drying process inclusive of the three unique stages of sun-drying helps with the ultimate goal of creating an optimal flavor for high-quality products. MMC also provides extension services through networking with farmers to arrange buying routes for wet cacao, outreach to farms to ensure their farms are in line with the organic certificate requirements, and technical assistance aimed at improving quality and growing yields.

Toledo Cacao Growers Association (TCGA)

TCGA is a non-governmental organization based in the Toledo District which seeks to improve the socio-economic standards of farmers through income generation from cacao production which incorporates sound environmental practices. More than 200 hundred farmers from 55 communities within the Toledo and Stann Creek District are engaged in cacao production and members of the TCGA. TCGA continues to work with farmers in providing extension services for farm visit, improving production, providing training, purchasing cacao, and dealing with the exportation of cacao to the local and international market. TCGA liaises with the relevant civil society, public and private sector to streamline communication and support effective policies and through research and practices policy development and building local capacities of farmers to increase cacao productivity. Since its inception in 1984, TCGA is one of the oldest enterprises in Belize that has been purchasing cacao from local farmers of the Toledo and Stann Creek District and in 1993 the organization was the first certified fair-trade producer in the country and regionally.

Beekeeping in Belize

Belize has a rich history of beekeeping and honey production. **Historically, the Mayas were the first traditional beekeepers producing organic honey harvested from the hollow log nest of stingless bees and were subsequently cultured using traditional techniques.** Honey production from stingless bees for the Mayans was a significant source of dietary supplement and utilized for medicinal purposes and in religious ceremonies. Stingless bees remained the main honey makers until the mid-1900s when new species were introduced to Belize. European bees were first brought in from Mexico in 1957, as pollinators for the sugar industry in Corozal and Orange Walk Districts (Harrison, 2016). Additionally, commercial production of the honey from the species was initiated and led to the creation of seven cooperatives to develop a honey industry. The honey production from the introduced species yielded production significantly and honey was exported to the United Kingdom, Canada, Saudi Arabia, and the United States of America. The industry collapsed around 1987 when the aggressive Africanized bees were introduced into Belize and decimated the beehives. It was also documented that the rapid decline in bee colonies was because of the use of chemicals in marijuana plantations which were toxic to bees. Although the Africanized bees are considered heavy honey makers, beekeepers didn't have the technical skills and knowledge to manage these species, which resulted in farmers being discouraged in doing beekeeping. The decline in the late 1980s has led to limited effort to stimulate beekeeping and to grow the honey industry. However, the Ministry of Agriculture was able to enhance its own capacity in the management of Africanized bee apiaries and subsequently transfer the knowledge to the beekeepers across the country. Technical knowledge and skills to manage Africanized bees has led to a drastic increase in honey production in Belize in the early 2000s. Despite its economic benefit, competition with the Africanized honeybee is affecting the diversity and abundance of various bee species such as native stingless bees (*Meliponinae*) in Quintana Roo, Mexico (Cairns, 2002) and perhaps a similar case in Belize. Consequently, the native bees traditionally used by the Maya are now disappearing, along with the practice of keeping them.

Honey is currently produced throughout Belize with beekeepers concentrated in the Orange Walk and the Cayo District. Honey production is consumed locally to supply the local market and is not currently exported mainly because the existing cooperatives can only supply the local demand. Other by-products of honey include pollen, propolis, wax, and royal jelly which are sold locally. The Belize Marketing and Development Corporation (BMDC) through its Honey Buying Center was established in 2017 aimed to develop and promote high-quality local products by sourcing raw honey from the beekeepers of northern Belize. Beekeepers are now able to focus on increasing honey production manufactured and marketed by BMDC under the brand 'Belize Jewels'. This is positively impacting the lives of beekeepers and their families, as it reduces the effort required for marketing while allowing them to sell their honey in bulk and generate income in a short period of time. BMCD ensures that the beekeepers are paid a fair price for their products and the standing forest is preserved through the sustainable use of its resources. Other beekeepers especially in the Toledo and Stann Creek District harvest and market their own honey to supply the tourism domestic market.

Figure 6 below shows Belize honey production levels for the past 20 years. The highest production peak of 78 metric tons was recorded in the year 2000 associated with the revitalization of beekeeping and improved management of the Africanize bees. On the contrary, fluctuation in the production level varies throughout the past twenty years, perhaps linked to poor management practices, lack of organized groups of beekeepers, and lack of technical assistance to support beekeeping. Beekeepers are also facing competition with other imported adulterated honey products which are cheaper than quality honey produced in the country. The positive outlook on the rise in honey production supported by the Ministry of Agriculture's technical support through beekeeping equipment and training to promote good management practices of beekeeping. Belize has over 139 beekeepers managing 3,057 hives in 208 apiaries and generating over 45 metric tons of honey. Apiculture is a practice that has a

low impact on the environment and contributes to environmental conservation and sustainable development. The beekeeping industry of Belize helps improve the livelihoods of rural communities through poverty alleviation, diversifying income-generating opportunities, increasing food security, and increasing crop yields. There is great potential for the honey industry to expand which will significantly contribute to the economy of Belize by generating revenues and expanding honey production to supply international markets.

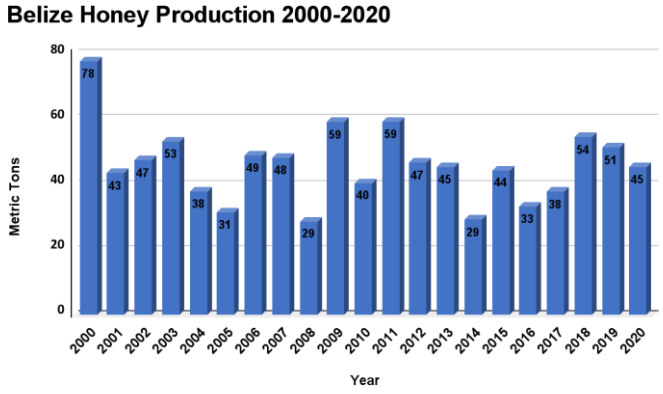


Figure 6. Honey production levels for Belize from the period of 2000 to 2020. (Source: Ministry of Agriculture, Food Security and Enterprise)

Ya'axché Beekeeping

Beekeeping is an important practice utilized by farmers to complement the agroforestry work being implemented across the MGL of the Toledo District. Toledo is known for its high forest cover which continues to support the viability of the honey industry. Ya'axché beekeepers understand and value the importance of bees as pollinators which help create and maintain forest health that people and animals depend on for ecosystem goods and services. Ya'axché started to work with four farmers in 2009 and further expanded to working with seventeen (17) farmers in training and building the capacity of farmers interested in beekeeping as an alternative source of income. The training module is designed into sections that consist of the beginner, intermediate and advanced modules which help build farmer's technical skills and knowledge in apiary management, good beekeeping practices, pest control, and bee hiving separation techniques; all of which are facilitated by the Ya'axché beekeeping specialist. Ya'axché also provides training to beekeepers to design their marketing capacity to market their product and most of their product is marketed locally to supply the local market. Exchange visits between Ya'axché beekeepers and other beekeepers across the country are conducted as an opportunity for knowledge exchange as a way to improve their beekeeping practice and techniques. Technical assistance is also provided to new beekeepers through the donation of beekeeping equipment, which is project-based. Ya'axché also conducted a native bee inventory in protected areas and agroforestry farms of the MGL and documented fifteen *Meliponini* species. Perhaps with the dissemination of a native bee guide, it is worth exploring native stingless bees to produce honey among farmers as a way to preserve the stingless beekeeping tradition. Figure 7 below shows the honey production from the MMNFR and the farmlands of the MGL, while income generated continues to increase annually as shown below in Table 2. Fluctuation among the years is perhaps attributed to climatic factors affecting the flowering season of standing trees and disturbances from unfavorable weather conditions which affect honey production level. Although honey production continues to increase over time, having a significant economic benefit to the beekeeper and contributes to preserving the standing forest which supports the jaguar population across the landscape. There is high potential for expansion because beekeeping as an alternative livelihood initiative is socially, economically, and environmentally sustainable.

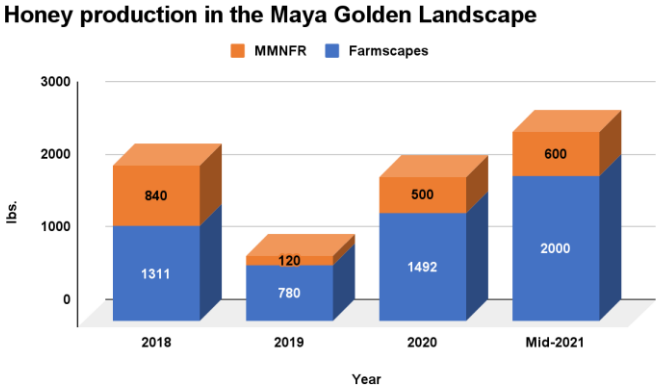


Figure 7. Honey production in the MMNFR and farmlands of the MGL.

Table 2. Revenue generated from honey production in MMNFR and farmlands of the MGL.

Year	Honey Yields	Unit Price	Total Cost
2018	2,091	BZ $6.00	BZ $12,546
2019	2,021	BZ $6.00	BZ $12,126
2020	1,992	BZ $6.00	BZ $11,952
Mid-2021	2,300	BZ $6.00	BZ $13,800

Inga Alley Cropping System

Ya'axché finds innovative ways to ensure communities across the landscape become resilient to the impact of climate change and strongly encourages farmers to implement sustainable farming practices such as inga alley cropping. Inga alley cropping is a new technique promoted by Ya'axché since 2013 and implemented by farmers across the MGL of the Toledo District. *Inga edulis* commonly known as bri bri or ice-cream bean is a leguminous tree that has the nitrogen fixation ability to form a symbiotic relationship with nitrogen-fixing bacteria to transform nitrogen gas into fixed nitrogen compounds usable by plants. Inga is a tolerant species that can survive in poor soil conditions, thus turning degraded lands into productive lands and a pioneer species with rapid germination and growth rate. This cropping system can help provide a wide range of environmental services such as improving soil fertility, soil stabilization, revegetation, shade, and shelter for weed control and supporting biological interaction, thus prolonging the usage of the land. It also provides edible fruits for consumption and whenever the tree is pruned, the branches are used for firewood or to make biochar. In an effort to provide the necessary technical skills and knowledge, Ya'axché staff and ten farmers had an exchange visit to the Inga Foundation in Honduras to learn and understand the inga alley cropping system and how

the model can be replicated on their farm. In 2013, Ya'axché supported farmers to establish demonstration plots of alley cropping using the madre de cacao and *Inga edulis* and used them as training sites for other farmers to learn about the technique and cultivate their own. Madre cacao *(Gliricidia sepium)* is a nitrogen fixing tree that can be planted to stabilize soil, to prevent erosion and to reclaim denuded land. It can also be used for live fencing for cattle pasture, a fodder bank for livestock, and a cover crop with inga alley cropping. Currently, twelve (12) farmers from six (6) communities of the MGL are implementing the inga alley cropping system with annual crops such as corn and beans planted both in farmlands and in the annual crop section of the MMNFR agroforestry concession. Farmers also cultivate coffee plants (*Coffea arabica*) which is a shade-tolerant crop planted among madre de cacao and *Inga edulis*. Ya'axché provided technical assistance through donations of inga seedlings and capacity-building training for farmers to enhance their farming techniques. In 2020, Ya'axché also assisted farmers with a variety of vegetable seeds that were planted into the inga vegetable garden demonstration plot as a new element to strengthen the utilization of the inga alley cropping system. Pioneering this cropping system yielded abundant produce to farmers, ultimately contributing to food security while utilizing the land sustainably.

Figure 8. Inga alley cropping system utilized by one of the farmers in the MGL.

Slash and Mulch System

Farmers of the Mayan communities across the Toledo District utilize slash and burn agriculture as a traditional farming system to plant annual crops such as corn and beans. Slash and burn agriculture is a method of cultivation in which forests are cleared and burned to produce fertile soil; however the patch of land can be fertile for two consecutive years and eventually soil fertility decreases and weed takes over the land, leaving farmers to find another forest to clear and burn down. An alternative technique to this traditional practice is the slash and mulch, where vegetation is cut and left to decompose. Ya'axché strongly encourages farmers to practice this sustainable farming technique as a way to restore degraded land and utilize the land sustainably as well as to support the movement of wildlife in the landscape. Slash and mulch systems provide soil enrichment which helps restore the health and nutrients of the soil needed to increase crop productivity. Slash and mulch systems also maintain soil biomass supporting biological interaction and reducing the fallow period which makes the land reusable, ultimately reducing deforestation. Mucuna (*Mucuna pruriensa*) also known as velvet beans is a leguminous plant often used as a cover crop in the slash and mulch to help increase crop yields, improve soil fertility, and weed control in southern Belize. There are fifty-three (53) farmers using slash and mulch agriculture to cultivate their annual crops. In 2019, thirty-one (31) farmers cultivating in the MMNFR have harvested 26,000 bunch of plantains, 49,600 pounds of corn, and 3,000 pounds of peppers. Slash and mulch systems facilitate food and livelihoods security while maintaining the health of the ecosystem.

Figure 9. A slash and mulch system utilized by one of the farmers in the MMNFR.

Tourism in Belize

The Tourism industry is one of the main economic pillars of Belize, generating the greatest contribution growth of the annual Gross Domestic Product (GDP). In 2019, tourism contributed to 29% of Belize's GDP supporting over 170,000 employees across the country. The tourism sector represented over one-third of Belize's GDP in 2019, which made it the most tourism-dependent economy in continental Latin America (Lopez, 2021). Belize's tourism attraction is characterized by having natural resources, biodiversity, and cultural heritage that make it possible for ecotourism, cultural tourism, and adventure tourism to prosper as the main motivator for tourists to visit Belize. It plays an important role in Belizean livelihoods through employment and business opportunities for income generation and is the largest foreign exchange and revenue generator. Tourism continues to develop rapidly, venturing into the path of sustainability and playing a fundamental role in furthering sustainable development and investment in tourism-related opportunities such as ecotourism, adventure tourism, and nautical tourism. However, the industry collapsed in 2020 amidst the Covid-19 pandemic and related restrictions that resulted in numerous job losses, business closure,

and the operation of the industry was hampered and drastically declined. Belize also experienced significant economic contraction as a result of the Covid-19 pandemic with the total value of goods and services stood at 592.6 million dollars when compared to 682.2 million dollars of 2019 (SIB, 2021). This has led to a 13. 1% declined in the Belizean economy for 2020 inclusive of the tourism industry. Despite the GDP decline for 2020, the country is expected to recover in 2021 with the new economic recovery strategy set in place by the government of Belize. In terms of the tourism sector, the Ministry of Tourism and Diaspora Relations created a tourism recovery plan that will bolster tourism and create innovative opportunities to alleviate unemployment, uplift business initiatives, and having a mechanism for tourism operators to adopt certain standards necessary for reopening in a reality shaped by Covid-19.

The Ministry of Tourism and Diaspora Relations is the ministry under the government of Belize that aims to provide leadership, strategic direction, good governance, and oversight on all matters relating to the development of tourism. The ministry envisioned the country to be globally recognized for leadership in tourism in promoting cultural identity and environmental resilience guided by the relevant tourism and environmental policies and legislation as well as having a National Sustainable Tourism Master Plan to strategically guide tourism development in Belize. Additionally, the Belize Tourism Board is a statutory body that is there to impact tourism development by working in close partnership with the public and private sectors to develop and market tourism products through good governance and strategic initiatives. The entity is also responsible for the implementation of tourism policies to address the changing needs of the tourism industry both nationally and internationally which will continue to foster the socio-economic growth of Belize.

Figure 10 below illustrates the trend in Belize Tourism GDP for the past decades as the tourism industry's contribution to the GDP increased steadily, rising from 20.6 percent in 2008 to 29.2 percent in 2019. However, the tourism industry's contribution to the GDP drastically declined to 11.5 percent as a result of the Covid-10 pandemic that impeded the tourism operations. Nonetheless, the economy is projected to recover in 2021 and is expected to be driven by economic growth in a number of economic sectors, including a recovery in tourism which is expected to reopen for tourists, with the containment of the Covid-19 through vaccination of the Belizeans to bolster tourism operations.

Tourist arrivals to Belize have increased every year for the past decades at a rapid pace as shown below in Figure 11. In 2019, tourist arrivals to Belize exceed over 500,000 making the highest number of visitors in the nation's history. This also indicates that there has been a growth rate of 2.8% in 2019 when compared to 2018 showing a positive uptrend. However, the positive outlook was abruptly impacted by the pandemic in 2020 which resulted in a drop in tourist arrivals to 17,000, thus affecting employment and local business income. The pandemic and restriction to border closures and tourist reluctance to travel impacted the tourism industry harder. Despite the pandemic, 2021 shows a positive outlook for tourism to recover gradually.

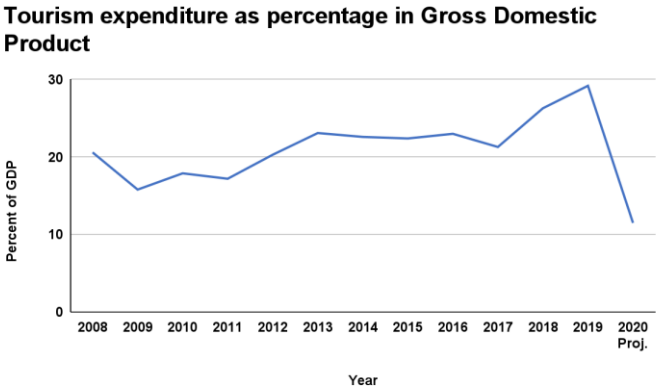


Figure 10. Tourism expenditure as a percentage in the GDP for the past ten years. (Source: Belize National Statistical System Portal)

Figure 11. The number of tourists visiting Belize for the past ten years. (Source: Belize National Statistical System Portal)

Ecotourism in Belize

The tourism industry of Belize is highly dependent on natural resources and cultural heritage assets, having tremendous economic benefits. It is therefore imperative that sustainable tourism development should be the way forward to foster socio-economic development and preserve the natural wealth of Belize. Ecotourism is one such tourism that attracts many tourists across the world to experience the many natural wonders of Belize without jeopardizing the natural resources. Relevant tourism and environmental policies and legislation are there to positively impact the tourism sector in a strategic direction ensuring the protection of the natural resources while contributing significantly to Belize's economic development. Ecotourism initiatives in Belize is an approach that many co-managers of protected areas promote as a way to generate revenue to support conservation efforts. Protected areas including wildlife sanctuaries, national parks, private reserves, and archaeological sites with diverse landscapes are the main ecotourism motivators in Belize. Additionally, many eco-friendly enterprises such as ecolodges, botanical gardens, and jungle resorts promote nature-based tourism, ultimately contributing to sustainable tourism as a way to generate revenues and provide employment while preserving the integrity of the forest. As much as tourism depends on Belize's natural resources, it contributes financially to invest in protected areas management via conservation fees paid by tourists upon departure and from

cruise ship passengers. The Protected Areas Conservation Trust is the entity that received these conservation fees and is the largest investor in the management of protected areas in Belize. To continue fostering economic growth in a sustainable manner, Belize needs to continue venture into ecotourism to create progressive changes towards the conservation of natural resources to attract more visitors while providing direct financial benefits for the conservation of protected areas.

Over the past decades, numerous tourist visitors have visited terrestrial protected areas, including wildlife sanctuaries, national parks, and archaeological sites. The tourist visitors for the protected areas continue to steadily increase over time with St. Herman's Blue Hole National Park in 2019 having 29,000 visitors, making the highest number of tourist visitors in 2019 and throughout the years followed by Cockscomb Basin Wildlife Sanctuary shown below in Figure 12. The preservation of intact forests from these protected areas is crucial for jaguar habitat conservation across Belize. For example, Cockscomb Basin Wildlife Sanctuary is the first jaguar preserve in the world and promotes ecotourism to generate revenues and has over 14,000 tourist visitors for 2019. In addition, Mayan sites are a must-visit destination in Belize with 12 major Mayan ruins visited by numerous tourist visitors over the past decades shown below in Figure 13. Xunantunich is the second largest site after Caracol which continues to steadily increase with the highest number of tourist visitors over the years and reaching up to 100,000 in 2019. Followed by Altun Ha as the second highest throughout the year with 81,000 visitors in 2019. The archaeological site is a historic landmark for Belize that continues to make Belize stand up to be a must-visit destination and meanwhile ecotourism is preserving the cultural heritage of Belize.

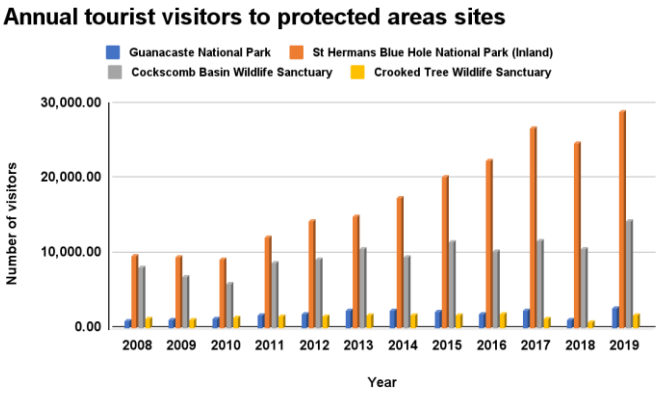


Figure 12. Annual tourist visitors to terrestrial protected areas for the past decades (Source: Belize National Statistical System Portal)

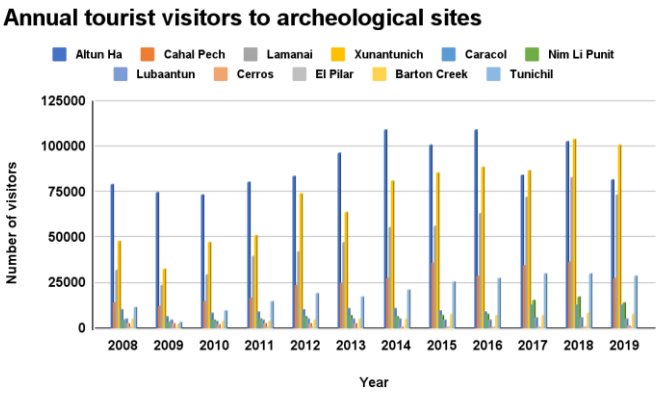


Figure 13. Annual tourist visitors to archaeological sites for the past decades

EcoTourism Belize

Ya'axché Institute for Conservation Education (YICE) is a business initiative geared towards sustainable financing to support the ongoing conservation work of its parent organization, Ya'axché. Since its inception in 2014, YICE aims to protect wild places and wildlife while supporting sustainable livelihoods of communities across the MGL of the Toledo District. Ya'axché's goal towards financial sustainability under YICE has two major components which consist of EcoTourism Belize and the nursery. Operating as a social business, EcoTourism Belize is connecting nature, wildlife, and communities for a more sustainable world. It continues to provide transformative experiences to foreign and local visitors as a tour operator which consist of eight ecotours namely the ranger for a day, river patrol, Mayan cultural visit, birds of Belize, and eco-farm tour, among others. EcoTourism Belize also provides experiential learning via study abroad programs for international university students and researchers and provides eco-friendly accommodation for visitors. Education programs are built on Ya'axché's works in protected areas management, biodiversity research, and monitoring, and community outreach initiatives via climate-smart agriculture implemented by farmers and environmental education. Additionally, EcoTourism Belize empowers local communities by supporting local enterprises in marketing their products and services, all of which help enhance livelihoods through income generation while supporting conservation and community development. Figure 14 below shows the number of tourist arrivals from 2014 to 2019, which indicates that visitors are most interested in ranger for a day tour followed by farm ecotours and Maya Cultural Experience. For the year 2020, there were no tourist visitors due to the onset of the Covid-19 pandemic and related restrictions that resulted in business closure. Although, 2021 shows a positive outlook where EcoTourism Belize was reopened for business and has hosted student groups and other visitors as depicted below in Figure 15. Ecotourism Belize as a business initiative continues to increase in number of visitors progressively. This initiative is a model that can be replicated by community-based organizations for sustainable financing to support their conservation efforts, ultimately having significant social, economic, and environmental benefits.

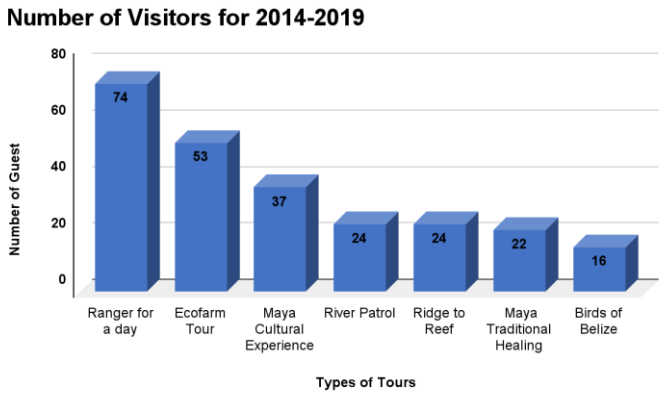


Figure 14. Tourist visitors for EcoTourism Belize in 2014 to 2019

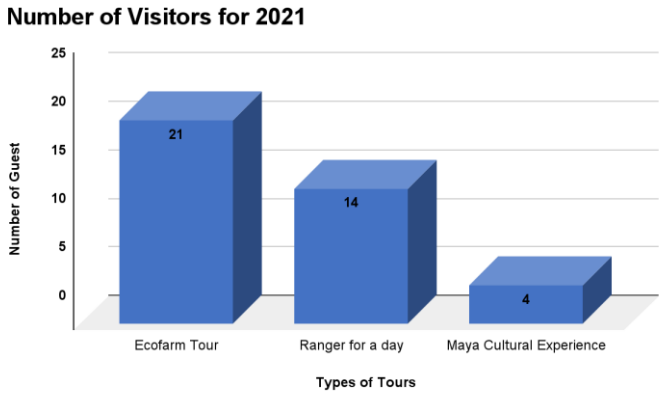


Figure 15. Tourist visitors for Ecotourism Belize for 2021

Figure 16. An international student group at one of the protected areas Ya'axché comanage for their fieldwork as part of their study abroad program.

Human-Jaguar Conflict Resolution

As stipulated in the Wildlife Protection Act, the Forest Department is the responsible entity to respond to reported jaguar attacks across Belize. Over the years, the Forest Department provided advice to farmers on livestock husbandry techniques to prevent the loss of livestock from jaguar predation. Some of these basic best practices include having secure fencing, night enclosures to keep jaguars out of the pasture, and the integration of donkeys to protect livestock from the jaguar. Sharing knowledge on basic husbandry techniques to the farmers will not only be protecting their livelihoods but allows for the jaguar to continue to survive in the landscape. Farmers tend to get frustrated whenever a jaguar attacks their livestock or domestic animal and retaliates against the jaguar. To reduce the number of jaguars persecuted, a Rehabilitation Program was established in 2003 by the Belize Zoo in collaboration with the Government of Belize and the United States Fish and Wildlife Service to shelter jaguars that have been injured or causing a repeated attack on livestock (MFFSD, 2014; The Belize Zoo, n.d.). Rather than killing the problem jaguars, they are held in captivity with proper care and serve as public education at the zoo. In 2017, conservation stakeholders all over Belize came together to form the National Jaguar Working Group (NJWG) aimed at collaboration to promote jaguar conservation across Belize (University of Belize, 2018). The NJWG's relevant stakeholders included the government agencies, academia, research institutes, protected areas managers, and non-governmental organizations that serve as the advisory committee to the Belize Forest Department for addressing the jaguar issues nationally. The NJWG was actively involved in addressing jaguar issues across Belize for a while until it became dormant.

Ya'axché Human-Jaguar Conflict Program

Ya'axché started to respond to frequent calls on jaguar attacks from several villages in the Toledo District. The first recorded attack to which Ya'axché responded occurred in 2013 (Carlisle & Lopez, 2019). Ya'axché along with the Forest Department personnel responded to numerous jaguar attacks that occurred between 2015 to 2017 in southern Belize. The coordinated effort was to document jaguar attacks and provide advice to the farmers on how to prevent jaguars from killing livestock. Based on anecdotal reports, jaguar predation was mainly on livestock such as calf and sheep as well as on domestic animals such as dogs (M. Ack, pers. comm.). Frequent jaguar attacks that have occurred embarked Ya'axché to establish the Human-Jaguar Conflict Program geared towards responding to calls from communities on jaguar conflicts across the MGL of the Toledo District. Under this program, Ya'axché executed three projects aimed at raising awareness in communities around the MGL on the importance of protecting jaguars and learning to live in coexistence. The program shifted its focus to working directly with cattle farmers in the Southern Biological Corridor who were facing cattle losses due to jaguar attacks. The project recruited nine cattle farmers as part of a demonstration farm to implement mitigation measures which include solar lights, sound alarms, and secure fencing, and subsequently evaluate their effectiveness in deterring jaguars from the farms. The project revealed that cattle farmers and jaguars can coexist especially with the technical support provided with mitigation measures in which the solar foxlight turns out to be the most effective strategy to deter jaguars from the farm. There was also a positive change in farmer's attitudes towards jaguars perceived as a nuisance because there was an alternative approach to reduce jaguar attacks rather than killing the jaguar. With the recruitment of a human-jaguar officer, close communication with local communities was effective to share knowledge on improving husbandry management to reduce livestock depredation. Ya'axché continues providing support by encouraging farmers to implement mitigation measures and to follow advice on best husbandry practices to reduce livestock depredation. A total of seven (7) cattle farmers from five communities manage jaguar-friendly farms by implementing the guided mitigation measures as an alternative approach for

securing livestock as the jaguar continues to thrive in the human-influenced landscape. Camera trap monitoring effort around the jaguar-friendly farms shows that jaguars and other wildcats traverse the fragmented landscape as well as supporting prey bases. Additionally, the jaguar documented around the farms is not attacking the cattle but traversing the landscape. In Belize, Ya'axché is the only non-governmental organization working on this conservation issue in southern Belize.

Figure 17. A jaguar detected by a motion sensor camera trap around one of the jaguar-friendly farms in the MGL.

Perspectives of Key Stakeholders

Information gathered indicates the different stakeholders involved in jaguar conservation and their effort in addressing gaps and issues encountered. Other stakeholders inclusive of the government entities, private sector, and few non-governmental organizations are both, directly and indirectly, involved in jaguar-friendly activities and sustainable livelihood initiatives across the landscape. It also highlights the gaps and challenges stakeholders endure and opportunities that can be promoted to continue to support jaguar conservation in Belize. A few of the stakeholders provided training and technical support to address gaps and challenges in various aspects of the different sustainable livelihood initiatives which were project-based. Limitation includes both human and financial resources which determine the extent of the work effort.

To gather different perspectives on jaguar conservation and promoting jaguar-friendly activities and sustainable livelihood initiatives, a virtual interview was conducted with key stakeholders from the non-governmental organizations, government entities, and the private sectors. A total of eighteen (18) stakeholders which participated are as follows:

1. Belize Audubon Society (BAS)
2. Belize Foundation for Research and Environmental Education (BFREE)
3. Belize Wildlife Referral Clinic (BWRC)
4. Corozal Sustainable Future Initiative (CSFI)
5. Forest Department (FD)
6. Foundation for Wildlife Conservation (FWC)
7. Friends for Conservation and Development (FCD)
8. Maya Mountain Cacao Limited (MMC)
9. Ministry of Agriculture, Food Security and Enterprise (MAFSE)
10. Ministry of Tourism and Diaspora Relations (MTDR)
11. Naia Resort and Spa
12. National Biodiversity Office (NBO)
13. Panthera
14. The Belize Zoo and Tropical Education Center (TBZTEC)
15. Toledo Institute for Development and Education (TIDE)
16. University of Belize Environmental Research Institute (UBERI)
17. Wildtracks
18. Ya'axché Conservation Trust (Ya'axché)

Four (4) stakeholders namely the Sarstoon-Temash Institute for Indigenous Management, Programme for Belize, Ecotourism Association, and Toledo Tour Guide Association didn't provide any response to the invitation to participate. An invitation letter was sent via email to stakeholders and the date and time of the interview were scheduled based on the availability of the different personnel. Stakeholders are selected based on their jaguar conservation effort and form an important part in promoting jaguar-friendly activities and sustainable livelihoods initiatives across the landscape. Stakeholders from the environmental sector engage with Ya'axché to support and promote the conservation of Belize's natural resources in protected areas management, biodiversity research, and monitoring, and involvement in workshops and capacity building exercises. Other stakeholders from the tourism and agriculture sector engage with Ya'axché community outreach and livelihood programs on climate-smart agriculture and with Ya'axché Institute for Environmental Education through EcoTourism Belize. A short questionnaire was created that included topics such as research and monitoring effort, human intervention in response to conflict, technical support provided to mitigate predator attacks, and on jaguar friendly activities and sustainable livelihood initiatives implemented as well as on education and outreach. The virtual interview with each stakeholder was conducted via google meets and the meeting was recorded for note-taking purposes. The script was developed using the audio recording in a thematic coding response for easy report writing. Besides the virtual interview, a literature review was conducted to gather all available information on jaguar conservation across Belize.

Human-Jaguar Conflict Intervention

Predatory attacks from jaguar, puma, and coyotes on livestock and domesticated animals are anecdotally reported across Belize. When a predator attacks livestock, farmers would often make a report to the relevant authority and at times most conflict issues are under-reported. Information gathered from the virtual interview indicated that protected areas managers and other stakeholders including BAS, BFREE, BWRC, CSFI, FWC, FCD, Panthera, TBZTEC, UBERI, and Wildtracks have received a report of predator attacks from buffer communities. Responding to calls on jaguar attacks is not part of the stakeholder's mandate and diverting the report to the FD as the relevant authority. An untimely response from the relevant authority often leads frustrated farmers to retaliate against the predator or blame the stakeholders for not rendering assistance. FD gets involved in response to human-wildlife conflict across Belize as part of their

mandate; however, the limitation of the effort is based on budget availability for transportation and equipment such as camera traps and batteries. With the inadequate resource, FD assists the needy farmers based on the frequency of the attacks. Whenever a follow-up is made by the FD, a few of the stakeholders namely BFREE, CSFI, and TBZTEC would tag along to assist during the site visit. Under the conflict program, UBERI in conjunction with Panthera responded to the human-wildlife conflict issue for five years (2012-2017) in the Maya Forest Corridor (MFC). TIDE does not get involved in response to calls on jaguar attacks due to no report received from buffer communities. As for the NBO, it is a fairly new government entity aimed at biodiversity management and protected areas management. NBO will look forward to finding priority areas aligning to biodiversity targets and will encapsulate keystone species (jaguar) as well as have an emphasis on addressing biodiversity issues at a national level.

Data Collection Protocol for Predatory Attacks

FD, Panthera, and UBERI were familiar with the established protocol to collect information on predator attacks and was developed by Panthera in collaboration with a group of experts from the NJWG. The protocol was given to the FD to collect information in response to conflict that includes investigating the area during the site visit in search of evidence for the predator attacks and about farm management practices. Based on the information gathered, will determine whether follow-up is required or deployment of camera traps to detect predators involved in the conflict. The protocol is outdated and extensive and requires revision.

Intervention to Address Predatory Attacks

The majority of the stakeholders stated a response team that can work independently to respond to human-wildlife conflict is required across Belize. FD has six offices countrywide where each game warden that works with the wildlife program is supposed to respond to human-wildlife conflict. FD as the relevant entity does not provide a timely response perhaps due to human and financial resource limitation that limits the effort of the department. Farmers that report conflict issues and left unattended or an untimely response tend to make farmers frustrated and would not want to report upcoming conflict issues to the relevant authority. Community involvement and having a close working relationship with farmers also play a crucial role in addressing human-wildlife conflicts. In addition, a centralized location of a wildlife network hotline will be useful for people to contact the relevant authority to make a report on conflict issues. FD as the relevant entity should be manning this initiative and should not be housed at FD at a district level but for organizations to assist in the response. Another intervention could be working with farmers to strengthen livestock management and implement mitigation strategies to reduce predatory attacks. A framework on human-wildlife conflict can be designed at a national level to identify key players and solutions to address conflict based on available information or research to influence decision-making. For example, compensation has been discussed but there is no structure or policy to ensure Belize is in the right direction in addressing conflict issues.

Mitigation Strategies to Address Predatory Attacks

A few of the stakeholders namely the FD, Panthera, TBZTEC, and UBERI have been involved to provide technical support to farmers having predatory attacks on their livestock. The technical support provided was project-based, thus having a short-term impact. FD as the responsible entity provides mitigation measures such as solar lights and building night enclosures to farmers depending on the frequency of the attacks and the availability of the resources. Panthera and UBERI provided mitigation measures to farmers in the MFC in an effort to reduce cattle depredation and to improve husbandry practices. This was part of experimental farms selected to determine the effectiveness of the mitigation tools. Similarly, TBZTEC under a past project provided mitigation measures such as solar panel motion lights that were given to FD to distribute to farmers having conflict issues.

Other Conservation Initiatives

Stakeholders namely BFREE, CSFI, FWC, and TIDE are involved in camera trap surveys of jaguar and prey species in the protected areas stakeholders managed and co-managed. FCD also conducts wildlife monitoring via line-transect survey for every two years and camera trap survey in protected areas FCD co-managed. While FD conducts short-term monitoring using camera traps around the farm to detect the predator involved in the conflict. BAS assists researchers to carry out jaguar research as well as mammal monitoring will be initiated in one of the protected areas BAS co-managed. Panthera has conducted social research on jaguar and prey species and an ongoing camera trap survey of jaguar and prey species monitoring in protected areas and the MFC. Presently, UBERI is undertaking a social survey on prey species from a local hunter perspective in the MFC. Both Panthera and UBERI's research on jaguars has been instrumental in the establishment of the MFC.

Additionally, BWRC provides medical service to injured or imperilled wildlife such as jaguar injured as a result of the human-jaguar conflict. The clinic launched a Wildlife Ambassador Program in 2018 aimed to get community members and law enforcement officers involved in wildlife rescue and provide humanitarian human-wildlife conflict resolution that includes jaguar as one of the conflict species. TBZTEC launched the Problem Jaguar Rehabilitation Program in 2004 aimed at housing problem jaguar in captivity without being killed and serve as public education at the zoo. Wildtracks does not have a specific jaguar initiative but falls under the threatened species program. Under that program, Wildtracks assisted in the development of national strategies namely the Belize's National Biodiversity Strategy and Action Plan that included the strategies and activities that needs to occur at a national level to ensure species such as jaguars have forest connectivity for their continued survival as well having wildlife laws in place.

Potential Jaguar Friendly Activities

The majority of the stakeholders are protected area managers involved in enforcement and compliance as well as in research and monitoring. Stakeholders do not focus on implementing jaguar-friendly activities or sustainable livelihoods activities. Instead,

provide a channel of communication with FD whenever a conflict is reported, wildlife aid, rehabilitation, and awareness as well as wildlife monitoring using camera traps. Several stakeholders would like to implement jaguar-friendly activities in the future that would be based on funding availability. Both BAS and CSFI want to establish a jaguar club geared to children and youths as a medium to share information on the importance of jaguar and their prey species as well as engaging the target groups in activities. FCD wants to promote a field method course in Runaway Creek Nature Reserve geared to primary school students to be involved in fieldwork such as identifying wildcat tracks and sharing knowledge on wildcats and about the nature reserve as a stronghold for wildlife. TIDE wants to focus on promoting awareness of jaguars as part of their terrestrial education component. The organization recommended having a jaguar awareness week at a national scale engaging all stakeholders involved in jaguar conservation across Belize as this could be similar to reef week that is held annually in Belize. In terms of providing technical support to farmers, Panthera reiterated that the method of giving materials to reduce jaguar attacks didn't seem to work. A promotional strategy is needed to get farmer's buy-in into employing the mitigation strategies. In this way, farmers will take ownership of the mitigation strategies on their farm, as this farm can be a model to share the experience with other farmers to get involved to adopt the mitigation strategies. BFREE also recommended technical support for farmers to improve husbandry management (secure fencing) that will reduce predatory attacks on livestock. Moreover, UBERI recognized the need for promoting awareness to increase the knowledge of farmers and the community as a whole on jaguar ecology and their prey species associated with human consumption rate, reproductive system, and their importance. The previous effort shows that farmers are reluctant to change; therefore, education geared to children and youths is important to change the mindset as they will be the future generations. In addition, expanding on monitoring in the MFC is important focusing on prey species for the purpose of population estimates as this will address the lack of information on prey species in Belize.

Other stakeholders such as BWRC, FCD, FD, TBZTEC, and Wildtracks want to continue building on their ongoing initiative. BWRC wants to continue to strengthen the Wildlife Ambassador Program to reach out to the wider community, thus increasing impact. While FCD and Wildtracks will continue to build and strengthen the awareness campaign on illegal wildlife trafficking and trade that includes illegal selling of jaguar parts. FD wants to continue to build on the technical support provided to the farmers in an effort to reduce predator attacks as this will depend on the available budget. At a landscape level, TBZTEC is working with communities across the MFC to safeguard 950 acres of forested land. This newly purchased property is part of the MFC that will allow for jaguars and other wildlife to thrive, thus having jaguar-friendly landscapes.

Education and Outreach

As part of the stakeholder's education and outreach program, jaguars and their prey are highlighted both directly and indirectly in activities to educate and raise awareness to buffer communities. BAS shares information based on jaguar research findings conducted by researchers at Cockscomb Basin Wildlife Sanctuary to student groups and visitors. BWRC shares knowledge on wildlife and the role of community members to report conflict issues and injured wildlife. A pocket guide on Wildlife Law and Human-Wildlife Conflict is a resource used to inform people on hunting season of game species and species protected by the law as well as to increase knowledge on wildlife conflict and species involved. FD under the Wildlife Program distributes brochures on ways to protect livestock to farmers and informs the farmers to report predatory attacks whenever it occurs. FD also shares information on hunting season for game species and the requirement of getting a hunting license to farmers. To increase their impact on educating the farmers, FD wants to initiate a teaching session in partnership with the Agriculture Department that will involve exchange visits to learn how farmers among each other have their husbandry management. FCD promotes awareness campaigns on illegal wildlife trafficking and trade as well as on fire prevention campaigns as it can be detrimental to wildlife and the environment. Panthera provides guest lectures on their jaguar research work to bachelor students under the Natural Resource Management Program at the University of Belize.

TBZTEC used to run competitions such as writing poems and essays about jaguars to students across Belize. A jaguar named junior buddy was a high-profile ambassador for the species that engaged students from different communities in activities to increase awareness of the species. Junior buddy died in 2019 and other jaguars held in captivity are being trained to take on the role of an ambassador for their species. TBZTEC also works with communities in the jaguar-prone areas mainly in the MFC to share knowledge on jaguars and associated human-jaguar conflict. Workshops were also conducted for teachers across the community in the MFC by providing a syllabus on the importance of jaguars, the human-jaguar conflict, and the corridor that will later be taught in the classroom for primary school children. UBERI has conducted several meetings with communities in the MFC on the importance of the corridor for jaguar and their prey species and brochures on the topic were also distributed. Wildtracks in conjunction with the FD developed wildlife in the law document and trained protected areas officers, FD officers, and other enforcement officers to be well-informed on wildlife law and addressing wildlife crime and trade such as selling illegal jaguar parts. TIDE does not necessarily do outreach on jaguars and their prey but continues to strengthen fire management by building the capacity of stakeholders and raising awareness on the impact of wildfires and how to do a prescribed burn during the fire season. This contributes to reducing wildfires and how to be responsive to wildfires as it can be detrimental to the ecosystem and wildlife. The organization will include the terrestrial component in the Community Research Program to help with camera trap monitoring. Other stakeholders including BFREE, CSFI, and FWC focus on promoting their work in protected areas management and conservation rather than supporting jaguar and their prey directly.

Collaborative Efforts

Stakeholders collaborate with other organizations to carry out jaguar conservation work in areas of research and monitoring, training, rescue, and in response to conflict issues. BAS will continue the mammal monitoring in St. Herman Cave National Park with the help of UBERI as the main partner. The organization

needs help in training to learn to conduct basic analysis on camera trap data and will seek help from Panthera. BFREE collaborates with Panthera to carry out coordinated research efforts and with FD to report conflict issues. BWRC collaborates with TBZTEC, FD, and FCD on the Wildlife Ambassador Program. CSFI partnered with Panthera for personnel to get trained in establishing a camera trap survey and with FD to report conflict issues. FD partnered with Panthera to train FD personnel to respond to jaguar attacks and is currently working to see how they could align the countrywide camera trap data to determine patterns and trends. The department also conducts collaborative work with Panthera and Ya'axché to respond to human-jaguar conflict. FD wants NGOs that are comanagers of protected areas to get involved to report human-wildlife conflict issues from the community due to their availability on the grounds and can easily contact FD to do a follow-up. These comanagers can also be involved in monitoring when there are frequent attacks in the community. FCD will work closely with Panthera to carry out the wildcat survey in protected areas FCD co-managed and to report the conflict to FD. FWC works closely with Panthera to carry out jaguar research in Runaway Creek Nature Reserve and wants to continue building working relationships to help each other in research and monitoring. FWC also works with FD to report conflict issues.

Panthera has partnered with YCT and FD to carry out human-wildlife conflict responses in the past. The organization also partnered with UBERI to design a standard methodology for camera trap monitoring used by stakeholders involved in research and monitoring. FCD will be a new partner that Panthera will help in the wildcat camera trap survey. TBZTEC partners with Panthera, UBERI, and Wildlife Conservation Society as part of a coalition in the MFC and wants to continue to strengthen the collaborative effort in being stewards of forested lands as part of the MFC. The collaborative effort will include fire management and establishing a working group with the partners to streamline communication. The zoo also works closely with FD to respond to conflict. TIDE has partnered with Panthera regarding the methodology used to conduct camera trap work. The camera trap work was paused for a while and will soon be reinitiated, and TIDE will seek help from Panthera to learn basic analysis of camera trap data and identify individual jaguars. UBERI collaborates with Panthera to carry out jaguar research in Belize and collaborated with Panthera on the execution of a five-year conflict program along with the FD. Wildtracks partners with the FD, BWRC, Belize Bird Rescue, and TBZTEC focusing on threatened species. In 2018, a workshop was hosted by Wildtracks in conjunction with the FD on drafting the National Wildlife Awareness Strategy for Belize that included human-jaguar conflict with conservation partners. Wildtracks continues to strengthen its partnership with the FD and is currently hosting a series of workshops to identify and finalize the national threatened species list for mammals that include jaguars.

Gaps and Challenges

Information gathered from different protected areas managers and other stakeholders involved in jaguar conservation indicated the different approach that has been conducted in Belize to support jaguar conservation. However, different interventions are required to continue the effort as well as to share knowledge and awareness of jaguars across the landscape. A collaborative effort with these stakeholders is required to address these issues at a national level and develop a strategic plan that will guide the action required for the limitations to be addressed and mitigated. Three specific challenges highlighted by the stakeholders are as follows:

1. There is inadequate support from relevant authorities to respond to human-jaguar conflict across the landscape and a lack of consistent data collection on the conflict issue.
2. Insufficient technical support to mitigate predatory attacks often leads to retaliatory killing of jaguars as the last resort, thus threatening the jaguar populations.
3. Lack of advocacy and awareness in regard to the relevant authority to report jaguar attacks and the importance of jaguars and their wild prey.

As a unique conservation issue across the landscape, human-jaguar conflict is an emergent threat affecting farmer's livelihoods while threatening the already struggling jaguar population through the retaliatory killing of jaguars. Recommendations to address these issues at a national level are as follows:

1. A national response network to respond to conflict issues across Belize is required mainly because FD as the responsible entity cannot provide a timely response given their financial and technical resource limitation. Given the dormant existence of the National Jaguar Working Group, relaunching would ensure networking with stakeholders to have a strategic plan in place that will identify key players and the different approaches that will be taken to address conflict issues. This can be conducted through a series of workshops building the capacity of enforcement officers like FD Game Warden in each station across Belize and rangers from non-governmental organizations (NGOs) that are comanagers of protected areas. Capacity building workshops will allow enforcement officers to know how to respond to reports of predator attacks, conduct a proper site visit in their respective district and use the existing protocol to collect the necessary information on the predator attacks and farm management practices. Although the established protocol is extensive and outdated and requires revision for necessary information to be collected on conflict issues. Spatial Monitoring and Reporting Tool (SMART) application can be used for the data collection and management as a way to systematize data collection across the country. This tool is utilized by comanagers of protected areas for enforcement and compliance, hence the depredation protocol can be built into SMART tool for easy digital data collection. Establish a hotline for the proper communication channel to report predator attacks to the relevant entity. In this approach, a timely response to conflict issues will be made across the landscape.
2. Another recommendation is providing technical support to farmers that are experiencing frequent predator attacks. Mitigation strategies can be provided to farmers to help reduce and prevent predator attacks. There are available studies that outline the different anti-predation strategies that can be employed on the farms to deter predators (Hoogesteijn & Hoogesteijn, 2014; Quigley et al., 2015) as well as advice on best practices to improve husbandry management. Allocation of financial resources through grants and government support will allow for technical assistance to be provided for the

farmers to improve their husbandry practices and preventative measures can also be provided to reduce and prevent predator attacks. This will secure the livestock of the farmers, and farmers do not have to retaliate against the jaguars, allowing jaguars to continue to survive in the human-influenced landscape. Similarly, a compensation scheme can be established to help farmers to compensate their livestock lost as a result of predator attacks. For example, in Calakmul, Mexico, there is a compensation scheme for predation which allows affected farmers to get compensated for their livestock loss by a predator (Marshall et al., 2020). Having this approach in place in Belize will allow for farmers to get compensated for their loss, and of course with a standard data sheet to gather proper and accurate information to facilitate the process thoroughly.

3. For a national response team to work effectively, a national educational awareness campaign can be initiated via social media, community meetings, local and national radio shows, inter alia, to share the information about jaguars and their prey. It will also allow the dissemination of information on the relevant entity in their respective district for farmers and residents to call in to report conflict issues. The dissemination of the information can also be implemented through NGOs and other relevant stakeholder's education and outreach programs at the community level. Securing financial resources is required for this to occur across Belize. One of the stakeholders recommended for a jaguar awareness week to be held annually involving all stakeholders that are involved in jaguar conservation. This can be a medium to share the work they have relating to jaguars or wildlife conservation in general as this can commemorate international jaguar day. Different mediums such as national radio shows, social media campaigns, a trivia challenge, and competition can be used to communicate the message across Belize. Other stakeholders reiterated the launching of a jaguar club geared to children and youths which will foster the knowledge and heighten the awareness of the target group on the importance of jaguars and their prey.

Farming System Approach

Agriculture is one of the main economic activities that is practiced by many rural communities across Belize to sustain their livelihood by increasing food security and income generation. With Belize having a diverse culture, each farming practice varies significantly across the country as well as with the different topography, climatic conditions, and soil types which also influence the variety of crops cultivated. For example, the northern part of Belize is known for its vast sugar cane production, while for central Belize, the vegetables and beekeeping, and southern Belize are dominant with cacao, citrus, and banana production. However, beekeeping, cacao-based agroforestry and inga alley cropping farming techniques can be replicated in other parts of Belize. To look after forests, one must look hard at agriculture development as it can have a tremendous impact if not promoted in a sustainable manner. Information gathered from stakeholders interviewed from the agriculture sector shows the different roles they play in the value chain of cacao and honey production. Other annual crops grown by farmers are for self-sustenance and to supply the local market.

Ministry of Agriculture, Food Security and Enterprise Approach

The Ministry of Agriculture, Food Security and Enterprise (MAFSE) under the Belize Agriculture Department at the district level provides extension service to farmers cultivating agricultural goods to supply the local market. Whenever MAFSE receives projects, they provide technical support and training to farmers in areas of beekeeping, cacao farming, livestock management, and vegetable production to improve their farm management practice as this maximizes productivity. MAFSE also assists in finding niche markets for farmers to sell their products and their value-added products which continue to generate income for farmers as part of livelihood security.

Ya'axché Approach on Climate-smart Agriculture

For Ya'axché, the climate-smart agriculture promoted and implemented by farmers under the community outreach and livelihoods program complements the work of the organization in protected area management. The overall goal is to improve the community's livelihoods while conserving biodiversity through the implementation of climate-smart agriculture. This enables the farmers to increase their production on their farms in a sustainable manner without having to encroach on protected areas. These sustainable practices include cacao-based agroforestry, inga-alley cropping, slash and mulch, and beekeeping. Each of these practices is interrelated as they serve to provide food security and generate income for farmers. Ya'axché envisioned these farming practices in the MGL to be a model that can be replicated elsewhere ensuring there is minimal energy lost amongst the different practices and further venturing into agroecological farms which will continue to support the ecosystem by restoring degraded lands and utilizing forested land sustainably. Ya'axché working with communities for over twenty years advocating their work in protected areas management, biodiversity research, education, and outreach, and promoting climate-smart agriculture led to a positive impact on community development, ultimately building a high reputation for the organization.

A comprehensive approach of the organization through the community outreach and livelihoods program educates and raises awareness to bring about behavioral change in communities, which is a gradual process and multi-tiered. Ya'axché liaises with community leaders to be aware of the work the organization is promoting in communities, all of which is approved by these leaders, and applauds Ya'axché's effort in working with farmers to improve their livelihoods. For farmers, their buy-in to become part of the program to implement the different farming practices is dependent on their self-interest and the benefit towards their livelihoods as well as the technical support Ya'axché provides for initial investment which is mostly project-oriented. The continuous extension services and training Ya'axché provides also play a crucial role in sparking the interest of the farmers to continue the practice. The annual farmer's expo of the organization also influences farmers by acknowledging the top farmers who are practicing climate-smart agriculture effectively. Ya'axché also helps farmers to access niche markets to sell their products at the local level. Additionally. farmers engaged in implementing the

farming practice with Ya'axché and decide to leave the program, the farmer will continue to maintain his farm independently. Farmers recognized the benefits of these different farming activities which improve their livelihoods through crop diversification ensuring food security and income generation while cultivating the land sustainably and conserving biodiversity and ecosystem services.

Cacao Production

MAFSE under the Agriculture Department, Ya'axché Community Outreach and Livelihoods Program, and Maya Mountain Cacao (MMC) recognized the importance of cultivating cacao in an agroforestry system as this is mostly concentrated in the Toledo District. Cacao production creates livelihood opportunities for farmers through income generation while providing forest connectivity and habitat for wildlife. These stakeholders provide extension services to cacao farmers on how they can improve the management of their farms and help facilitate the purchase of wet cacao beans to the cacao buyers. Over time the cocoa production continues to increase as documented by MMC as the main cacao buyer in southern Belize. MMC promotes the practice of organic farming and facilitates the process for farmers to have their farms organically certified and farmers working directly with Ya'axché are part of this certification scheme. As part of the criteria to be identified as a certified organic farm, farmers need to have shade trees and create buffer zones in the area, all of which are supporting biodiversity conservation while adhering to environmental practices. Few farmers working with Ya'axché and MMC also promote their organic cacao farm through ecotourism initiatives, allowing them to educate both local and foreign visitors on the farming strategy they are utilizing both having economic and environmental benefits. However, there are major gaps and challenges facing the cacao industry which includes:

1. Other competitors purchase cacao from farmers without having criteria in place, which affects the organic certification system of MMC and subsequently leading to resistance and lack of commitment from farmers to continue the practice of organic farming.
2. Lack of government recognition of farmers engaging in agroforestry practices.
3. Pest and diseases such as Molinia continue to affect cacao production.
4. Inadequate technical support from the government for farmers and for cacao buyers to continue growing the cacao sector
5. Lack of standardized data collection system to track cacao production accurately amongst key players in the cacao sector.

To address these gaps and challenges, the government must develop and enforce relevant policies and legislation that will impact the cacao sector along with key players involved to play their part to drive the economic growth of the cacao industry. Recommendation to address gaps and challenges highlighted are as follows:

1. With Belize having a National Agroforestry Policy, the government under MAFSE needs to step up to enforce the policy and engage key players to grow the industry as well as help key players such as farmers and cacao buyers to bolster their role in the cacao sector. For farmers, the government has a role to play to recognize the effort of farmers through the creation of a standardized system to provide incentives and formally acknowledge the effort of organic cacao farmers to stand out as this can potentially spark the interest of other farmers to venture into sustainable farming practice. Organic cacao farming has significant environmental and economic benefits and there needs to be a mechanism in place from the government allowing competitors and investors to follow a system to source cacao from organic farmers to encourage the practice of agroforestry.
2. With relevant help from the government in having a mechanism in place for cacao-agroforestry, this will lead the industry to the path of sustainability which will influence the importance for farmers to be organically certified as this helps in pest and disease management. As mentioned by MMC, organic cacao farmers have minimal Molinia infestation, as this is a fungus infection affecting cacao pods when compared to conventional cacao farming. Monilia infestation can be prevented by conducting proper maintenance of the cacao farms and eliminating a tree that is affected by Molinia to avoid further spreading.
3. The government needs to continue with project development and implementation which can assist farmers with training and technical assistance to encourage organic cacao farming. Provide entrepreneurial training to farmers and other interested parties to diversify economic opportunities via value-added products. Government can continue seeking a niche market for farmers to sell their value-added products for a fair price. For cacao buyers like MMC that are using a sustainable business model, the government needs to provide tax exemption on import duty and help expedite the process of cacao exportation.
4. The government under the MAFSE and other key players such as cacao buyers in the cacao sector to establish a standardized data collection system to feed into a centralized repository system that will house all cacao production data collected from farmers upon purchasing wet cacao beans and to the exportation of cacao beans. In this way, cacao production can be tracked accurately and concisely to show the trends in cacao over time. For instance, the cacao data retrieved from the MAFSE have data gaps and through this approach, it can be addressed.

Honey Production

MAFSE and Ya'axché provided valuable information on the honey industry in Belize. For MAFSE, beekeeping is a livelihood activity for many rural communities on which they depend for income generation and has been utilized by farmers from the early 1900s. In 2015, the ministry refocused on beekeeping in which a five- year beekeeping strategy and implementation plan were drafted focusing on the input supply, policy, production management, and marketing aspect of honey with key stakeholders. Based on the history of beekeeping, the last five years show that the beekeeping industry continues to gradually grow. For Ya'axché, beekeeping is an alternative livelihood initiative for earning income and protecting standing forests beneficial for wildlife such as jaguars. Both stakeholders provide extension services to farmers and training in beekeeping and technical assistance as a start-up investment, which is project oriented. Honey production from

farmers is sold locally to meet the demand of the local market and few farmers also harvest by-products such as pollen, propolis, and royal jelly from beekeeping which is sold to diversify income streams. Beekeeping practice has high economic and environmental value; however, there are gaps and challenges affecting the industry which includes:

1. Lack of mechanism from the government to recognize farmers practicing organic farming to produce organic honey.
2. Inadequate technical support from the government to farmers to expand in beekeeping since the initial investment is costly and farmers are reluctant to be engaged. MAFSE lacks a standardized system to collect honey production data from farmers and other honey buyers.
3. Limited access and mechanism to link farmers to niche markets to sell their honey and other beekeeping by-products.
4. Introduction of pest and disease such as varao mite, a parasite that lives on bees and can affect the bee's performance in the honey making when there are high infestation and hive beetles which can infest honey in hives by releasing substance making the honey ferments and resulting to poor quality of honey.
5. Climate change and other climatic conditions cause irregular flowering seasons of trees in the forest, and this affects the pollination season for beers, ultimately affecting honey production.

Beekeeping as an alternative practice for income generation and preserving standing forest have room for improvement and expansion to meet the demand of the international market. The government has a main role to develop and enforce relevant policies and legislation to influence key players in the industry to foster economic growth. Recommendations to address the gaps and challenges highlighted are as follows:

1. The government under the MAFSE should enforce the beekeeping strategy and implementation plan and identify key players to support the growth of the industry. Initially, there has to be a certification program to guarantee farmers on their best beekeeping management practices which produce high-quality honey and to get fair prices for their products. For example, the Belize Marketing and Development Corporation through its Honey Buying Center should expand in souring honey in bulk from beekeepers in central and southern Belize. Perhaps through this initiative, a certification program can be created as a mechanism required upon purchasing honey from beekeepers.
2. MAFSE needs to continue with project development and implementation in areas of technical assistance and capacity-building training to recruit more farmers in beekeeping as a way to increase honey production to meet the growing demand of the international market. Most farmers have low socioeconomic status and need start-up capital to venture into beekeeping and this is where the ministry and other stakeholders can assist or provide micro-loans to existing beekeepers to expand their apiaries. MAFSE also needs to establish a standardized data collection system in order to have a centralized repository system to house all honey production data collected from farmers and other honey buyers. In this way, honey production can be tracked accurately and concisely to show the trends in the beekeeping industry over time. For instance, the honey data retrieved from the MAFSE have data gaps and through this approach, it can be addressed.
3. The government under the MAFSE should continue to connect farmers to niche markets to get reasonable prices for their honey and provide training for farmers to venture into exploring beekeeping by-products as a way to diversify their income streams and have a mechanism in place to brand organic honey produced by farmers as this can pave the way to supply for the international markets. For example, organic honey produced can be branded based on geographical indication to make it stand out in the niche market.
4. For MAFSE under the agriculture department at the district level to continue to provide extension services for farmers to improve their beekeeping management practice. If pests and disease are not properly managed, the beekeeping industry can collapse again. The MAFSE along with other key players needs to develop a pest and disease management treatment and build the capacity of farmers through training to improve management. A Beekeeping Specialist from the MAFSE stated that infestation is likely susceptible where there is poor management of apiaries.
5. To become resilient to the impacts of climate change, farmers need to venture into sustainable farming practices which in return have a positive impact on beekeeping. Ya'axché Beekeeping Specialist stated that beekeeping depends on standing forests which give different types of nectar, thus producing sweet honey (golden color) and similarly with cacao agroforestry and fruit trees. On the contrary, beehives set up in pine savannah and citrus orchards which bees depend on for their flowers produce bitter-sweet honey (dark brown color). This shows the importance of protecting standing trees and using sustainable farming practices for a positive impact on beekeeping and this can be one of the requirements for the certification program to make beekeepers stand out in implementing organic farming.

Inga Alley Cropping System

Ya'axché is the only organization working with farmers to implement the inga-alley cropping system in Belize. Ya'axché extension officers provide information crucial to show how this practice has and continues to help farmers across the landscape in southern Belize. With this farming practice, Ya'axché envisioned inga alley cropping as a technique to turn degraded lands into productive lands which helps improve soil structure and soil fertility and increasing crop yields while minimizing environmental impact. Farmers implementing this cropping system on their farms show a positive impact on their crop yields. Using this cropping system, the Inga tree produces fruit edible for consumption and when branches are pruned, it is a good source for firewood. Farmers are willing to implement something once they see the benefit as this is the same case with Inga alley cropping and there are farmers interested in expanding and new farmers willing to implement this technique. Farmers also cultivate cash crops such as coffee plants (*Coffea arabica*) which is a shade-tolerant crop planted with pioneer shade trees including Madre de cacao and *inga edulis*. Challenges and gaps in the further expanding on this farming technique are as follows:

1. Resources limitation which measures the extent of the work effort in sustainable farming practice across the landscape.
2. Limited human resources to provide extension service to farmers implementing climate-smart agriculture under the

Community Outreach and Livelihood Program.

3. Inadequate science involvement to document and monitor the cropping system environmental benefits.
4. No standardized data collection sheet to track crop production from farmers using the cropping system.

Ya'axché continues to show a positive impact of the inga-alley cropping system utilized by farmers to plant annual crops and other perennial crops. To continually improve on the cropping system, recommendations to address the gaps and challenges are as follows:

1. Ya'axché's development team will continue to write grant proposals geared towards the continuation of engaging more farmers into implementing the farming system. This will continue to increase the impact of the organization in promoting this climate-smart farming in the landscape of southern Belize.
2. With the available human resources, Ya'axché will continue to provide extension services to farmers and give them the necessary training required for them to take on the responsibility of managing their farms independently while the work continues. In that case, there can be room for other farmers who are interested to receive support in implementing the sustainable farming practice.
3. Strengthen the collaboration between Community Outreach and Livelihoods Program and the Science Program to expand wildlife monitoring in the cropping system and venture into other research efforts such as testing soil biomass in the cropping system.
4. Develop a standardized data collection sheet that will ensure the crop production is recorded and this can be useful to measure production and see trends in how these farming practices positively impact the livelihoods of farmers. Although farmers give testimonials on the benefit of using inga alley cropping system as it increases crop yields.

Slash and Mulch System

Slash and mulch is an alternative for slash and burns which Ya'axché continues to advocate for farmers to practice. Most of the farmers engaged in implementing cacao-based agroforestry and beekeeping utilize slash and mulch to cultivate annual crops such as corn and beans as these are the main staples for farmers. Slash and mulch farming improve soil health and increase soil biomass which helps increase crop yields while contributing to soil conservation. In addition, slash and mulch create a short-term ecosystem for wildlife to inhabit and support the movement of jaguars across the landscape. Jaguars traverse the farm to hunt prey such as peccary and coatis that are there to raid crops. For this practice, farmers work independently to cultivate their land as this is a traditional farming practice within the Mayan culture and Ya'axché provides minimal support. An issue is the lack of data to track crop production using this farming method, hence a data collection sheet needs to be developed to start collecting data on crop production. Ya'axché will continue to advocate the importance of using slash and mulch farming systems for farmers as it supports soil conservation and increases crop yield.

Cardamom: Highest Paid Cash Crop

Cardamom (*Elettaria cardamomum)* is a perennial crop belonging to the ginger family and seeds are used for cooking and medicinal purposes. Farmers in the Toledo District started to cultivate cardamom plants in 2016 and continues to expand among farmers and there was a drastic increase in production for the years 2020 and 2021. The cardamom plant is cultivated using a milpa system; however, farmers started to incorporate cardamom plants in the cacao-based agroforestry which resulted in higher yields when compared with milpa farming. Both cash crops have a symbiotic relationship that allows farmers to diversify income streams. Dry cardamom seeds are exported to Guatemala through an informal trade and the highest paid cash crop in the country (14 quetzals per pound equivalent to 3.64 dollars Belize). MAFSE will seek to establish experimental plots to find suitable management practices needed to cultivate the cardamom to give high productivity and to produce more seeds for distribution among interested farmers. The ministry will also seek a direct niche market internationally because the cardamom seed produced in Belize is bigger and of high quality when compared with the cardamom grown in Guatemala in which Belizean farmers are not getting the prime price for their product. This will also include getting experts to conduct training to build the capacity of farmers in cardamom cultivation.

Ecotourism Opportunities

Stakeholders from the government, a non-governmental organization, and the private sector consider ecotourism as a nature-based tourism initiative that has significant social, economic, and environmental benefits. Relevant tourism and environmental policies and legislation continue to influence tourism development in Belize and there lie tremendous opportunities to continue venture into ecotourism to create livelihood opportunities for communities and generate revenues for business owners whilst promoting environmental conservation.

Ministry of Tourism and Diaspora Relations Approach

The government under the Ministry of Tourism and Diaspora Relations is in charge of promoting sustainable economic growth through tourism development in areas of policy and legislation planning and implementation along with project development and implementation. Ecotourism is a tourism product that is heavily dependent on nature and cultural heritage, generating income for tourism operators and providing employment opportunities for many Belizeans. Archaeological sites continue to remain as one of the must-visit destinations in Belize and the government through the ministry continues to improve tourism infrastructure development and enhance tourism experience at archaeological sites via projects. Project implemented also seeks to make tourism benefit communities adjacent to archaeological sites across Belize as this will improve economic opportunities in rural communities and contribute to poverty alleviation. The ministry also develops projects to improve tourism facilities in various protected areas that are open as tourist attractions. Although there is no strong link between tourism and jaguar conservation, ecotourism initiatives across Belize preserve the natural environment, indirectly beneficial as a habitat for the jaguar population. To have a link between tourism and jaguar, there needs to be a package that will ensure ecotourism directly supports jaguar conservation. For

example, Cockscomb Basin Wildlife Sanctuary is known as the first jaguar preserve in the world that can be enhanced to attract more tourists through the improvement of facilities and adding other amenities, all of which continue to generate revenue to support the conservation work of the protected area. However, the ministry needs to continue with project development and seek financial support from international donors for the continuous support of infrastructure development in protected areas to enhance tourism opportunities. Engage stakeholders from the tourism sector particularly in ecotourism to provide entrepreneurial capacity building training to foster community-based tourism, ultimately improving the livelihoods of communities. The ministry will also continue to collaborate with stakeholders such as the Belize Tourism Industry Association and Belize Tourism Board to work both with stakeholders from the public and private sector to market tourism products to contribute to tourism development.

Private Sector-Naia Resort and Spa Perspective

Jaguar conservation is something to hold in high regard and the maintenance of corridors is very important to the county not only for the sake of tourism but for the sake of ecosystems. Protected areas can also be used as an ecotourism opportunity such as establishing natural trails and having other amenities to attract tourists for revenue generation to support the conservation work. Ecotourism allows our people to create livelihoods by having a meaningful job that is integrated with the environment allowing them to make enough money to raise their families. The iconic jaguar is used in promotional strategies in the tourism industry to attract tourists. In addition, the Belize Zoo gives the opportunity for tourists to see the jaguar and other wildlife of Belize, and these are rescued animals that serve to promote awareness of animals as this is a good ecotourism initiative helping to promote wildlife conservation. One of the main challenges of the tourism industry is unsustainable development projects approved by the government which can have a negative impact on the environment. Previous governments were considerate with going forward with massive tourism projects which were completely incompatible with the development trajectory of Belize as a nation. The problem is that money and politics can give the wrong consent. Belize needs a government that can advocate internationally for sustainable tourism development and is willing to stand to say no when there are investors for massive projects with detrimental impact on the environment. There is the Association of Protected Areas Management Organization (APAMO) as a mega non-organization community that advocates for the protection of natural resources and has stood up against the government when there are projects that can have a detrimental impact on the natural resources. There has to be a way to mobilize tour guides and other tourism stakeholders to stand in support of APAMO when there is a project with a significant impact on the environment. Encourage protected areas managers to venture into ecotourism opportunities like Cockscomb Basin Wildlife Sanctuary to generate revenue to support their conservation work. In this way, the forest remains intact while generating economic benefit.

Ya'axché Institute for Conservation Education Approach: EcoTourism Belize

Ya'axché Institute for Conservation Education (YICE) is the business arm for its parent organization, Ya'axché, which seeks to promote a social business called EcoTourism Belize as a sustainable finance initiative to support the conservation work of the organization. EcoTourism Belize is connecting nature, wildlife, and communities for a more sustainable world aligning with Ya'axché's vision in harmony between nature and human development for the benefit of both. EcoTourism Belize provides ecotours and experiential learning programs for international students based on the work of the organization in protected areas management, biodiversity monitoring, and research, climate-smart agriculture, and education and outreach. Engage communities with business opportunities to provide catering and eco-farm services for guests as a way to generate income for their households. With the women's group, EcoTourism Belize capitalizes on their native skills to promote the Mayan cultural experience to guests. The business continues to utilize the natural resource sustainably, build awareness with business partners to become stewards of their natural resources. It also educates communities on the importance of protecting the environment and wildlife and practice the use of sustainable agriculture to produce organic plants and crops as well as provide employment opportunities to local communities. Having a balance on alternative means of generating income and building awareness on sustainable resource use is crucial to attaining sustainable livelihoods. YICE also provides necessary capacity-building training to women's groups to enhance their service provider skills and assisting in the creation of business plans to develop their business and in marketing aspects to promote their products, most of which are project-based. Gaps and challenges highlighted for the initiatives are as follows:

1. Limited financial resources hamper the initiative to expand partnership with communities in creating livelihood activities. There is so much that can be done to help build the capacity of farms to develop their farms for tours as a lucrative business model, but resources are limited to provide necessary service. Inadequate marketing resources to do mass attraction with international partners.
2. No mechanism for recognition of ecotourism as a sustainable initiative to stand out for their commitment to sustainable tourism.
3. Lack of government support to improve ecotourism facilities in private protected areas.

EcoTourism Belize continues to have a tremendous impact in creating livelihood opportunities for communities with its limited resources while supporting conservation efforts. Recommendations to address the highlighted challenges are as follows:

1. Ya'axché development team to prospect potential grants and develop project proposals that will continue the work of the initiative while increasing their impact on communities and promoting the work of the parent organization. With secure projects, the initiative can execute activities such as capacity-building exercises for women groups and farmers to enhance their skills and knowledge as service providers. Continue to partner with international universities as it can generate revenues to build internal capacities of the initiative for growth and development.
2. The government under the Ministry of Tourism and Diaspora Relations should focus on promoting ecotourism initiatives by

having a certification program for initiatives to be branded as nature-based tourism having both economic and environmental benefits. A policy framework encapsulating nature-based tourism can influence decision-making and strategies on promoting protected areas as a sustainable tourism product as the way forward to financially support protected areas management for comanagers.

3. The Ministry of Tourism and Diaspora Relations should continue with project development and seek financial support from international donors to support ecotourism initiatives in private protected areas in infrastructure development. Perhaps the ministry through the Belize Tourism Board should enhance the marketing aspect of these initiatives as a niche tourism product to be considered a must-visit destination in Belize.

Conclusion

Belize is considered one of the last remaining strongholds for the jaguar population. Primarily, the biological corridors of Belize connecting landscapes with protected areas are essential to ensure the viability of the jaguar population. The connectivity between these landscapes forms an important part of the regional corridor initiative to support the movement of jaguars and other wildlife. The jaguar conservation effort across Belize is critical as the charismatic jaguar is culturally, economically, and ecologically important. The presence of jaguars as top predators signifies that the food web is still intact with wild prey mainly accounted for by the protected areas system and biological corridors as well as sustainable livelihood initiatives implemented across the agricultural landscape. However, the jaguar population is threatened by anthropogenic activities such as habitat loss from deforestation and subsequent fragmentation combined with overhunting of prey species, poaching, and the human-jaguar conflict. We recommend three major reforms to alleviate the threats to the jaguar population in Belize which include: active forest and wildlife law enforcement and environmental awareness should be increased, slash-and-burn agriculture should be replaced with climate-smart agricultural practices and the socio-economic conditions of rural communities should be improved through sustainable livelihood initiatives. Reformation of loopholes in legislation and policy framework can also influence the management of natural resources and guide the human development trajectory of Belize. **Recommendations to address these threats to the jaguar population at a national level are as follows:**

1. Outdated government policies also aid the deforestation rate in Belize. Simple amendments to the existing land-tenure legislation can have a significant impact on the deforestation rate and the subsequent fragmentation of Belize's forests (Young, 2008). Protected area management at both site and system level is not considered to be adequately protecting species of national and international concern (Walker & Walker, 2009). The terrestrial protected areas system is impacted by illegal hunting, illegal logging, and transboundary incursions (Walker & Walker, 2009) and limited human and financial resources for effective enforcement and surveillance in the Protected Areas System (MFFSD, 2014). Allocation of financial resources is required to increase human resources for enforcement and surveillance which will significantly strengthen enforcement of protected areas legislation and policies. Strengthen joint patrols with the Belize Defence Force to curb the transboundary incursion in the protected areas adjacent to the Guatemalan border. Continue to strengthen and build the ranger's capacity to conduct surveillance activities against illegal hunting in protected areas by increasing their knowledge of Wildlife Protection Act, effective enforcement and surveillance, and providing an understanding of conservation and protected areas management.
2. Lack of awareness on hunting season and the closed season, hence the allocation of resources is necessary to share knowledge at the community level. This can be initiated through the support of non-governmental organizations (NGOs) as part of their education and outreach. NGOs have direct community involvement via education and outreach. It is therefore imperative for a national collaboration to implement an awareness program, with increased awareness at national events, sensitizing communities on the regulation for jaguars and their wild prey as well as on the associated human-jaguar conflict. Relaunch the National Jaguar Working Group to provide the network with NGOs and other stakeholders to carry out this awareness campaign. This can also be the medium to share information on the relevant authority the community can contact to report a predator attack. Increase the human capacity of the FD to carry out effective spot checks on restaurants, markets, and meat shops suspected of illegally selling game meat species without a license. A collaborative effort with the Police Department is another way to strengthen surveillance via mobile patrols and inspection during checkpoints on the selling of game meat during the closed season and combating wildlife trafficking.
3. The government under various ministries responsible for the environment, agriculture, and tourism sector of Belize and with other stakeholders have a huge role to continue improving socio-economic conditions of rural communities through sustainable livelihood initiatives inclusive of sustainable agriculture and ecotourism opportunities. Although other stakeholders such as Ya'axché are taking the lead in fostering sustainable activities in the community of southern Belize through the implementation of climate-smart agriculture with farmers and engaging community groups as service providers for the EcoTourism Belize. The government needs to continue with project development which will provide technical assistance and training to farmers engaged in cacao-based agroforestry and beekeeping as this continues to have economic and environmental benefits. Moving away from slash and burn agriculture to sustainable agriculture practices such as slash and mulch and inga alley cropping can have a positive impact on farmers' livelihoods and the environment. An incentive-based intervention to combat this lack of willingness and spark the interest of farmers would be to offer certification of organic/sustainable agriculture farms, including livestock (Morrow, 2020). This can also be relevant to ecotourism initiatives operating in protected areas and across the landscape to have a certification mechanism for fostering sustainable tourism. This will also include the need

for more projects from the government to develop infrastructure in protected areas to improve tourism attractiveness and support community-based tourism in buffer communities of protected areas. Moreover, the government can also partner with stakeholders to transition cattle ranching into Silvopastoral practices to reduce the need to deforest forest areas and provide technical support for farmers to improve husbandry practices and other anti-predation strategies to reduce and prevent jaguar attacks on livestock. A compensation scheme can also be established to help farmers to compensate for their livestock lost as a result of predator attacks. For example, Costa Rica is the first government-funded jungle cat and livestock program that offers compensation for farmers whose cows have been killed by wildcats (The Tico Times, 2014).

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