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# Insights into the social ecological system of the Golden Stream Corridor Preserve in Belize through the assessment of direct use values and benefits

in fulfilment of the requirements for the academic degree of
Master of Science (M.Sc.)

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Dedicated to Marciana and Esteban Mesh: Ko’ox Marcia yetel Don Bli,
ta ok’laléexé pajchahin k’uchu náach.
Dyos bóotik yóolal tuláakal eh báax aj káansméextenó.

Táat, Dyos botik tush ka kanáantóonó.

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# ABSTRACT

The designation of state and private protected areas around the world has been increasing over the past years. Belize is not an exception to this reality. To date more than 103 protected areas have been recognized into the National Protected Areas System of Belize (NPAS). Private protected areas (PPA) did not become part of Belize's NPAS until 2015. But long before its legislation, private protected areas have been contributing to conservation and development in Belize. The Golden Stream Corridor Preserve (GSCP) is one of Belize's exemplary PPA which advocates for conservation through the promotion of sustainable livelihood development and community empowerment.

Using the co-evolution model by Pretzsch et al. (2014) as a conceptual framework, direct use values and benefits of the GSCP are assessed to gain insight into its social ecological system. A single case (embedded) case study design was used to execute this assessment at three buffering communities: Medina Bank, Golden Stream and Indian Creek. A total of 60 households, representing 10% of household leaders in each community were interviewed using a semi structured questionnaire. Community leaders were also interviewed to discover customary rules relating to resource use and the history of each community.

The direct use value assessment revealed that the GSCP only contributes to values associated with tourism and employment. These values were disproportionately distributed across buffering communities; with Indian Creek perceiving all values associated with tourism, and Golden Stream from employment. Medina Bank saw no direct use values from the GSCP. Community forests and lands were found to be the exclusive source of direct use values associated with the utilization of forest products. Sustainable livelihood development opportunities and community empowerment were the most reported benefits arising from the management of the GSCP. The adoption and contribution of livelihood strategies were however met with positive and negative criticism by community members.

Results from this evaluation epitomizes the importance of SES thinking in protected areas. Customary rules of resource use have contributed positively to the integrity of the GSCP. The impending threat of land use change and population growth at buffering communities calls for the creation of enabling environments for the adoption of sustainable livelihood through community participation, consultation, monitoring and evaluation.



**Keywords:** direct use values, coevolution model, social ecological system, Golden Stream Corridor Preserve, private protected area, Belize

# ACRONYMS

| | |
|---|---|
| BZD | Belizean Dollar |
| CBD | Convention on Biological Diversity |
| FFI | Flora and Fauna International |
| GSCP | Golden Stream Corridor Preserve |
| GST | General Systems Theory |
| IUCN | International Union for the Conservation of Nature |
| MAB-UNESCO | Man and Biosphere Program under the United Nation Educational, Scientific and Cultural Organization |
| MGL | Maya Golden Landscape |
| MLA | Maya Leaders Alliance |
| NGO | Non-governmental Organization |
| NPAS | National Protected Areas System |
| OECM | Other Effective Area-Based Conservation Measures |
| PA | Protected Area |
| PACT | Protected Areas Conservation Trust |
| PPA | Private Protected Area |
| SES | Social Ecological System |
| SIB | Statistical Institute of Belize |
| TTA | Toledo Alcaldes Association |
| USD | Unites States of America Dollar |
| WDPA | World Database on Protected Areas |

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# CHAPTER ONE

## 1. Introduction

Human wellbeing—utility—is a consequence of the Earth's ability to provide goods and services. Often grouped into provisioning, supporting, regulating, and cultural services; an ecosystem service is merely an anthropogenic construction which is very useful in understanding the dependence of humans on their natural environment. Environmental dependence often requires the alteration or management of the ecosystems to enhance the provision of ecosystem services. Consequently, ecosystem services around the world now face three major problems: more than 60% of them are being degraded or unsustainably exploited; degradation in most cases is irreversible; and the negative consequences of degradation and overexploitation are being borne by the poor (MEA, 2005). Additionally, the management of ecosystem and their services leads to the over simplification of ecosystems, reduction of diversity, fragmentation, and the creation of edge effects (including physical barriers) (Turner & Gardner, 2015). The Millennium Ecosystem Assessment (2005) and the Convention on Biological Diversity (UNEP-WCMC et al., 2018) have identified protected areas as extremely important "complementary" tools for biodiversity conservation and sustainable use of ecosystem services.

Today, more and more areas are being declared under legal protection as a direct response to the continued fragmentation and destruction of the natural world (Chape et al., 2005). At the writing time of this thesis, the World Database on Protected Areas (WDPA) reported that there are about 261,004 protected areas across 245 countries around the world (Protected Planet, 2020c). protected areas have become an important land use since they now cover about 9.7% of the Earth's surfaces; representing about 16% of the terrestrial area and about 8% of the marine environment (Protected Planet, 2020a). Protected area coverage is expected to increase to about 29% of global terrestrial surface by 2030 (McDonald & Boucher, 2011) and about 10 percent of global marine territory by 2035 (Boonzaier & Pauly, 2016).

Protected area thinking has experienced major paradigm shifts over the last decades. From being valuable conservation tools, protected areas are now accepted as complex social ecological systems (SES) where the feedback loops between the human and ecological dimensions are given importance. More so, the inclusion of adjacent lands as part of the protected area concept has been a major milestone (Mathevet et al., 2016). Understanding the values protected areas offer to buffering communities and the wider population, has been an important step in recognizing protected areas as a SES. Even more important is the fact that the valuation of these benefits arising from the protection ecosystem services kindle support for

them. This thesis embraces this ideology by using the Golden Stream Corridor Preserve (GSCP) as a case study.

### 1.1 Research question and justification

Forest cover in Belize remains the highest in Central America (Chicas et al., 2016). Protected areas in Belize have been proven to be very effective at halting deforestation. Cherrington reports that (2012) between 1980 and 2010, only 6.4% of forest cover in Belize's protected area have been cleared. Needless to say that more than 30% of Belize's terrestrial area is under some form of legal protection. Yet, an assessment of Belize's National Protected Areas System (NPAS) by Salas and Shal in 2015 revealed that the NPAS is fragmented, not cost effective, and not financially sustainable. Moreover, despite being one of Belize's most important assets in ecotourism and environmental services, the values and benefits of Belize's protected areas are poorly understood (Mitchell et al., 2018; Z. Walker & Walker, 2009).

Belize continues to designate forested areas as protected areas. The uncontrolled rates of deforestation and degradation of forests seems to be driving this behavior. In 2015 private protected areas (PPA) were legally recognized as part in Belize's NPAS. Recently, a large portion of Belizean territory was placed under private protection. In April of 2021, the Belize Maya Forest was purchased by The Nature Conservancy. Under a Trust agreement with the Government of Belize, more than 230,000 acres (95,506 hectares) of private land was purchased and placed under perpetual protection (The Nature Conservancy, 2021). Besides incentives such as tax exemptions and trust agreements, no formal management framework for PPAs have been developed. PPAs in Belize therefore run the risk of being mere conservation areas without contributing to the livelihood needs of Belize's growing population.

By using the GSCP as a case study, insight into one of Belize's unique protected area management schemes has been gained. The GSCP originated from a grassroots movement to protect the last block of forest connecting the Maya Mountains to the Caribbean Sea. The GSCP is also the only private protected area in Belize which is managed under an integrated landscape management approach which seeks to create "harmony between nature and human development" (Ya'axché Conservation Trust, 2019b). The GSCP has also been recognized locally and globally as a successful protected which has invested in the development of local livelihoods. Understanding the GSCP therefore has national and global importance. This thesis sought to answer the following questions:

1. What are the direct use values of the Golden Stream Corridor Preserve to the communities immediately adjacent to it? and

2. How adjacent communities benefit from the management of the Golden Stream Corridor Preserve?

At the local level, answering the two questions is fundamental for validating the management of the GSCP by the Ya'axché Conservation Trust (here after referred to as Ya'axché). Since the establishment of the GSCP in 1998, sustainable livelihood development has been promoted as a substitute for the protection of the land. After more than 20 years of management and implementation of projects, it is important to understand how communities have benefited directly from the management of the GSCP. At the national level, insight into the contributions of the management of the GSCP to the buffering communities can help guide the development of a management framework for PPAs in Belize. At the global level, the documentation of the contribution of PPAs to local communities can help redefine protected areas thinking.

Guided by these two research questions, the direct use values of the GSCP were enumerated. Under this guise, the objectives of this undertaking was to identify and quantify the consumptive and non-consumptive use of resources within the GSCP. Secondly, benefits arising from the management of the GSCP were also enumerated and analyzed. And finally, the case study was used to create a brief insight into the SES of the GSCP.

Findings of this case study are presented in six proceeding chapters. Chapter 2 discusses protected areas in the context of SES, presents ecosystem valuation techniques and provides insight into the emergence of PPAs around the globe. The conceptual framework guiding this thesis is also presented in the second chapter. Chapter 3 describes the study sites and reports on the methods used to collect and analyze data for this research. Chapter 4 analyses and summarized the results of each case study community. Findings in case study communities are compared and consolidated in Chapter 5. Chapter 6 discusses the findings and its implication for management. The last chapter (Chapter 8) draws on conclusions, provides an outlook and acknowledges the limitations of methods used in this research.

# CHAPTER TWO

## 2. Theoretical and conceptual framework

### 2.1 Understanding protected areas through the social-ecological systems lens

#### 2.1.1 From the general systems theory to social ecological systems theory

The emergence of the General Systems Theory (GST) between 1901 and 1950s (Bello, 1985) paved the way for the development of the social-ecological systems theory (Berkes et al., 2004). The GST allowed problems to be understood as systems made up of complex entities which interact with each other and their environment generating feedback loops. By the 1970s and 1980's ecologists had recognized the non-linear behavior of the natural environment and applied the GST to conceptualize environmental problems (Gunderson, 2000). In this framework, humans were recognized as creators and recipients of the emerging environment problems (Berkes et al., 2004). Berkes and his colleagues argue that his frame of thinking allowed the coining and the formalization of the social ecological theory.

Anderies et al. (2004, p. 3) define social ecological system (SES) as a "subset of social systems in which some of the interdependent relationships among humans are mediated through interactions with biophysical and non-human biological units". The social counterpart refers to governance, property right and access to resource, whereas the ecological dimension refers to the self-regulating communities of organisms (Berkes et al., 2004). However, understanding and combining the social and ecological counter parts as a whole is not a seamless process because both social and ecological spheres are complex in nature (Ostrom, 2007). Moreover, both disciplines have evolved separately and their interrelation has been only recently recognized. Ostrom (2009) nevertheless provides a simplified framework for understanding and visualizing the components and interactions in a SES.

Ostrom (2009) presents SES as a system which is composed of resource units, resource system, governance systems, user groups, and other related external ecosystems which interact with each other (Figure 1). Ostrom's model also acknowledges that SES exists within social, political and economic settings which are context specific. The ecological counterpart is referred to as the r*esource systems* (such as a lake) or an institutionalized arrangement (such as a designated protected area) from where r*esource units* (such as timber or water) are extracted. Resource systems and units are under the oversight of *governance system* which manage them. The *User* in a SES are the people or groups of people who use or benefit from the resource system. Ostrom (2009) and Berkes (2004) add that SES are not isolated units and therefore, its interaction with *related ecosystems* must be recognized. Although the framework decomposes the units within the SES, all these units *interact* with each other; creating *outcomes*. The interaction between

these first-level core systems results in dynamic feedback loops which feed into and out of the system (Berkes et al., 2004; Ostrom, 2007, 2009). Applying systems thinking through the SES in the natural sciences has led to the conceptualization of the natural world where humans are not antagonists but part of the natural system. This mode of thinking has proven to be important for the adaptive management of resource use and problem solving; especially in protected areas.

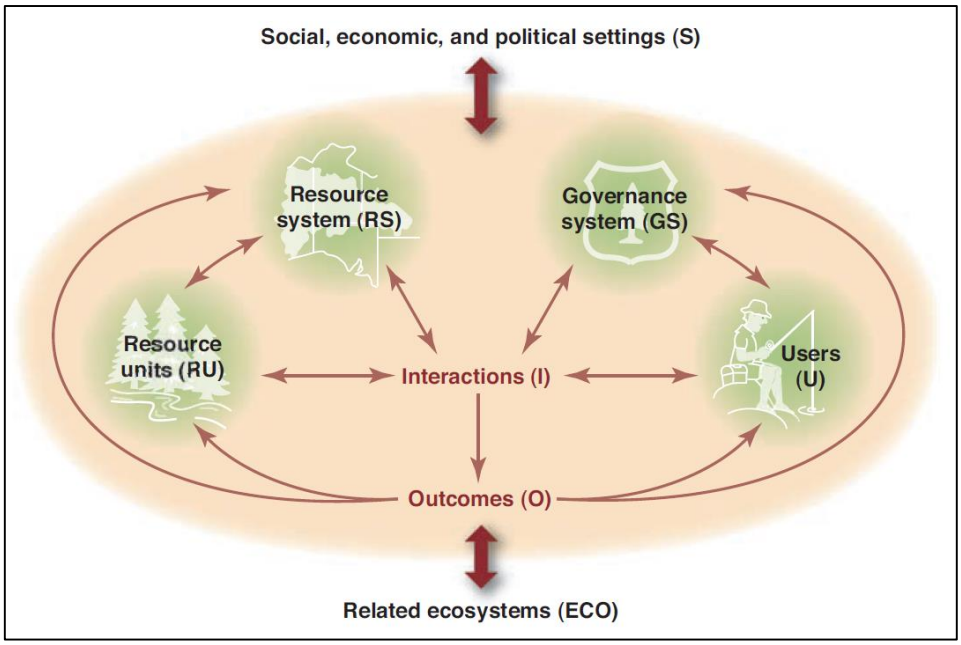



Figure 1: Major first-level core systems for analyzing and understanding a social ecological system (Ostrom, 2009, p. 420).

### 2.1.2 Protected areas as social-ecological systems

The International Union for the Conservation of Nature's (IUCN) definition of protected areas recognizes both the biological and social dimension of protected areas. A protected area is a "clearly defined geographical space, recognised [sic], dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (UNEP-WCMC et al., 2018, p. 2). In this context humans are no longer viewed as stressors of threats to protected areas, but as beneficiaries of the natural environment (Folke, 2006). This definition however fails to recognize that ecosystem functions and species within protected area boundaries, as well as management outcomes are embedded into larger ecosystems and surrounding lands [and waters] (Belote & Wilson, 2020; Hansen & DeFries, 2007). Cumming et al. (2015) suggests that given the pluralistic nature of protected areas, the SES is a useful framework for understanding and analyzing them.

The implementation of conservation strategies in protected areas often triggers a series of biological, social and economic responses. For instance, the prohibition of firewood gathering and fires in a newly declared protected pine savanna may lead to preservation of some species.

Local communities on the other hand may have to shift firewood collection to other areas, or will be forced to seek an alternative. Due to the accumulation of dead woody debris—from the absence of firewood collection and fires—in the longer run, forest fires may pose larger conservation problems to both the protected area and surrounding communities. By focusing on the feedback loops between managers, the natural environment and the social systems in a protected area, the SES is an important framework for balanced and nuanced approach to management (Cumming et al., 2015; Cumming & Allen, 2017; Therville et al., 2018). More specifically, according to Cumming et al. (2015) SES thinking in protected areas management brings attention to its resilience and sustainability at the landscape level; it emphasizes on the relevance of spatial context and scale of ecosystem services; and by recognizing that protected areas define and are defined by the relationships between the natural environment and people; and it redefines protected areas thinking.

The concept of resilience in the SES of protected areas refers to the ability of the system to undergo change while retaining its structure and function; the degree at which it can self-organize; and the it's degree of adaptability (Carpenter et al., 2001; Walker et al., 2004). The nonlinear responses and feedbacks between social and ecological systems results in several possible states of equilibrium (Walker et al., 2004). In the ecological realm, conservation effort focuses on maintaining ecosystem functions and services by inducing changes which do not exceed ecological thresholds (Cumming & Allen, 2017). In the social realm, attention is brought to the ability of actors to influence resilience through adaptive management and adaptive governance (Walker et al., 2004). Walker et al. (2004) emphasize that actors can avert undesirable system regimes, or can revert back to a desired state through adaptive management and governance strategies which maintain critical ecological resources.

Ecological and social dynamics are not confined within the borders of a protected areas. Protected areas are often surrounded by lands which are not protected (Belote & Wilson, 2020) and in many cases by other adjacent protected lands. The connectivity of protected areas therefore calls for the recognition of spatial and temporal scales as an important internal and external driver of resilience (Allen et al., 2016; Cumming et al., 2015; Cumming & Allen, 2017). Factors such as human pressures from agricultural, urban settlements and other land use on energy, nutrient and material flow, as well as organism movement at trigger localized and landscape level responses (Hansen & DeFries, 2007). Natural processes which have spatial and temporal scales such as phosphorus cycling and the succession of forests are important elements in protected areas management (Gunderson, 2000). Although less clear, Allen et al (2016) and Cumming et al. (2015) posit that the social scales in a system (protected area) are comprised of

local communities, as well as vertical and horizontal hierarchies of management. The scale of human movement for labor (livelihoods), or transhumance for instance, is an important dynamic within the social realm. The flow of information within the social scales has also been recognized (Allen et al., 2016). These include the exchange of ideas, perceptions and skills across local populations and communities (such as traditional ecological knowledge) as well as local to global stages and vice versa.

The inadequateness of protected area coverage reflected in current habitat loss and extinction rates, has called for the reframing of protected areas. Non-stationary approaches beyond the IUCN's protected area categories which addressed the dualism between human needs and conservation have been proposed and developed (Cumming & Allen, 2017). Already, under the Other Effective Area-Based Conservation Measures (OECM), the IUCN has acknowledged the need to support and recognize areas not declared as protected areas for the long term conservation of cultural, spiritual, socio-economic or other values (Protected Planet, 2020b). Other approaches such as the Man and Biosphere Program under the UNESCO has sought to conserve core natural areas without compromising the livelihoods of humans by reducing the human footprint by undertaking management in 3 zones (Ferreira et al., 2018). Other recent concepts such as ecological solidarity advocate for collective action to create sustainable cultural landscapes to complement and eventually replace state and market oriented protected areas management (Mathevet et al., 2016). By recognizing that ecological and social dimensions are not mutually exclusive, the SES frameworks paves the way for the redefinition of protected areas.

### 2.2 Ecosystem service approach in protected areas

#### 2.2.1 Ecosystem services and protected areas and humans

Human wellbeing is a consequence of the natural environment's capacity to provide ecosystem services. The term "ecosystem services" is an anthropocentric construction which describes the dependence of humans on the natural environment. The Millennium Ecosystem Assessment Report (2005, p. 53) defines ecosystem services as "the benefits people obtain from ecosystems". Four major categories of ecosystems have been defined in the Millennium Ecosystem Assessment. Ecosystems secure human wellbeing through the *provisioning* of tangible goods such as food and fresh water; the *regulation* of climate and other environmental conditions; the facilitation of *cultural* fulfillment such as spirituality, education and recreation; and the creation of essential *auxiliary [supporting]* services such as nutrient cycling and primary production. These "benefits" are directly associated to human wellbeing through the delivery of basic material necessary for life; attainment of good health; a sense of security; the

creation of social relationships; and allowing individuals to have freedom of choice (MEA, 2005). The degree in which ecosystem services contributes to human wellbeing varies according to the local context.

The dualism between the urgent need for the conservation of ecosystem services and livelihoods; especially in rural areas, has prompted debate on the contribution of protected areas to human wellbeing (Paul J. Ferraro & Hanauer, 2015). Evidence supporting the positive contributions of protected areas to human livelihoods and wellbeing are ambivalent. Ferraro and Hanauer (2015) for example attribute the reduction of poverty in Costa Rica to be directly linked to tourism in protected areas. Similarly, protected areas in Nepal have reduced overall poverty and extreme poverty through tourism and the supply of natural resources (den Braber et al., 2018). On the contrary, Foerster et al. (2011) found that protected areas in Gabon play an important role in providing forest resources, but were not directly linked to the wellbeing of households. An assessment on the contribution of the Maasai Mara National Reserve to the wellbeing of local communities in Kenya by Mojo et al. (2018), found that communities closer to the protected area were negatively impacted by the loss of crops and livestock. The heterogeneity associated with contribution of protected areas to overall wellbeing is therefore an important step towards their adaptive management.

The fact that ecosystem services and disservices are associated with protected areas indicates that they have intrinsic values. These values may be explicitly recognized in monetary figures, but more often they are only acknowledged worth based on opportunity costs (Costanza et al., 2017). The monetary valuation of ecosystem services; especially those provided by protected areas, has become an important topic in research and discussion (Costanza et al., 2017; de Groot et al., 2012; Janishevski et al., 2014; Philips, 1998). Much of this has been driven by the emergence of payment for environmental services, such as the carbon markets promoted by the REDD+ program. The valuation of ecosystem services has facilitated in narrowing the gap between conservation and the market system through payment for environmental services schemes (Jost & Ingo, 2014). Valuations may serve several purposes, the most important perhaps is to increase efficiency in the use of limited financial resources by identifying areas where protection and restoration is economically more important (Crossman & Bryan, 2009). Economic valuation is also an important tool for bringing awareness to the general public and policy development arena by highlighting the importance of ecosystems and biodiversity (de Groot et al., 2012). Mayer and Job (2014) for example report that German national parks generate a turnover of 2.1 bn €. Valuations like these have prompted support for the continued funding of protected areas, especially in areas where local economies are dependent on tourism.

Economic valuation of ecosystem services and those associated with protected areas are important; without a doubt, but the appropriate type of valuations or how to execute them has become the conundrum.

### 2.2.2 Valuation of ecosystem services

The Oxford Dictionary defines valuation as "judgement about how much money something is worth; its estimated value". A variety of ecosystem valuation methods have been developed. These methods can be grouped into two major categories: those that have an anthropocentric orientation; and those that place emphasis on non-human and intrinsic values through biocentric thinking (Jost & Ingo, 2014). These two approaches come together into what is known today as the total economic value (TEV) of an ecosystem. The concept of TEV emerged in the mid 1980's and is now an important tool for identifying and measuring the economic values and benefits of protected areas (Philips, 1998).

The TEV of a protected area is the monetary expression of the sum of its use and non-use values (Philips, 1998). Use values can be categorized into three main groups: direct use value; indirect use values; and option values (Figure 2). *Use values* refers to the consumptive aspects of an ecosystem. *Direct use values* are benefits derived from the harvesting, exploitation and liquidation of resources; the economic impact of protected area in terms of investments, wages and income; the economic impact of tourism in the region; the value of recreational experience in the protected area; and other intangible values such as research and upgrading of public infrastructure (Mayer & Job, 2014). *Indirect use values* are values associated with the ecological functioning of the ecosystem such as biodiversity protection, carbon dioxide sequestration or water purification; to name a few (Pascual et al., 2010). *Option values* are more ambiguous and whether they belong in this category has been debated. Nevertheless, option values refer to the costs PA users are willing to incur for the protection of future values such as the discovery of a valuable specie or other valuable resource.

Non-use values refer to the non-tangible values of a protected area: usually related to altruistic and philanthropic perceptions (Mayer & Job, 2014). The WCPA (1998, p. 12) defines *Non-use values* as "values which humans hold for a protected area which are in no way linked to the use of the protected area". Two major categories of non-use values are recognized: *bequest values*, and *existence values*, although *altruistic values* have gained attention in the recent years (Figure 2). *Bequest values* are based on philanthropic thinking, where the user is satisfied with the notion that someone else in the future will benefit from the existence of the protected area. *Existence values* on the other hand is pure altruistic thought where the user is satisfied knowing ecosystems and animals exist. *Altruist values* refers to the fulfillment an individual feels

knowing that other people (such as nonusers or the planet) benefits from the existence of a protected area (Janishevski et al., 2014; Mayer & Job, 2014; Philips, 1998).

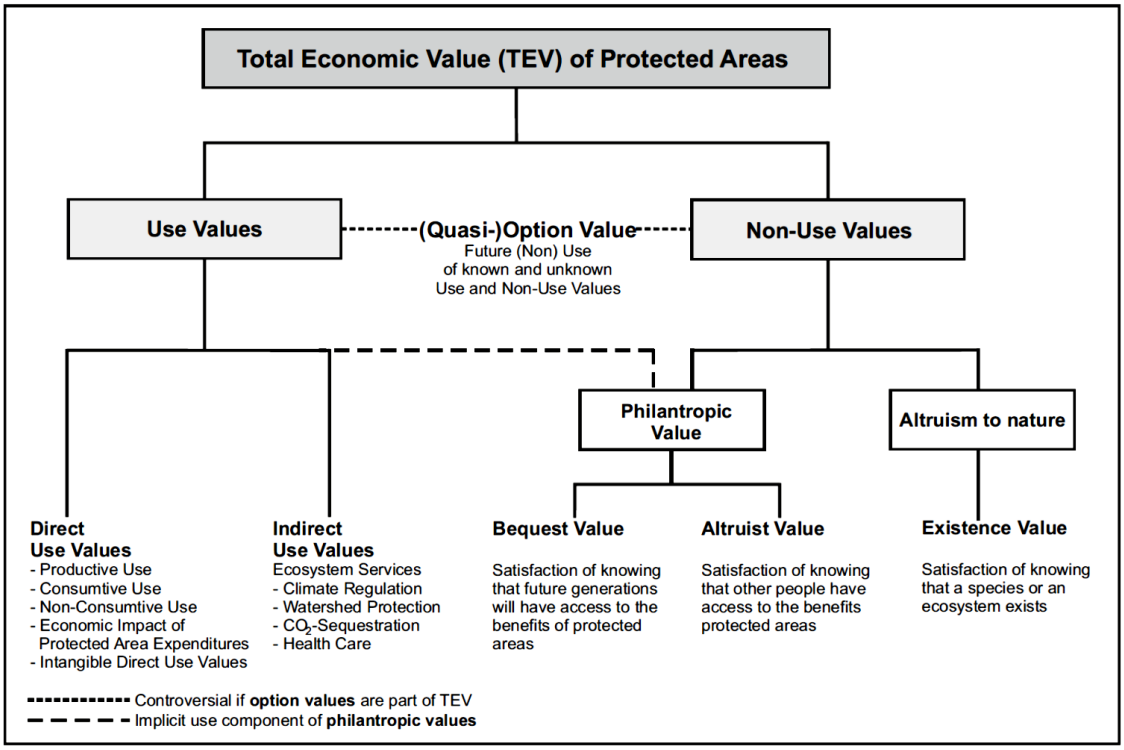



Figure 2: Total economic values of a protected area (Mayer & Job, 2014, p. 78)

Far from being a pure financial valuation, TEV is a very useful tool for valuing PAs because it also considers benefits which do not have a market price. However, the less tangible the nature of a protected areas value is, the more challenging it is to measure and valuate. Techniques for economic valuations are largely dependent on the availability of resources; the targeted audience; and the purpose for the valuation (Philips, 1998). These do not come without major shortcoming and criticism.

Valuation techniques can be categorized as revealed and stated preferences (Costanza et al., 2017). *Revealed techniques* analyze the choices of individuals in the real world setting and subsequently ascribes a value to that choice (ibid). *Product oriented* methods which value resources extracted from the protected area are the easiest and widely used techniques. This method quantifies resources and uses established market or informal values of goods generate an overall economic valuation. Other *indirect values techniques* such as change in productivity tries to ascribe a value on the contribution of ecosystem services (such as erosion reduction) to the generation of income such as agriculture (Philips, 1998). *Replacement costs* techniques ascribe economic value to ecosystem services by estimating the cost of replacing that ecosystem service (de Groot et al., 2012). For example, coastal protection provided by mangroves may be valued at the cost of constructing and maintaining a seawall. *Opportunity costs* techniques

calculate values of a protected area by estimating the values of the best alternative not realized due to its existence. For example, the income that would otherwise be generated if the area was replaced by agriculture. *Travel cost and hedonic pricing* are based purely on the preference of users. The sum of the expenses associated with visiting the protected area (travel time, travel cost and entrance fees) are assumed to be the economic value of the protected area. Hedonic pricing is oriented more towards the aesthetic values of protected areas (Philips, 1998). It assumes that economic figures such as the price of property close to protected areas reflect the value of the area.

*Stated preferences* are less market oriented. The most common techniques use experimental scenarios to determine user values. The *willingness of a user to pay* for an ecosystem services, and the amount a user is willing to pay; or the *willingness of a user to accept the loss* of an ecosystem service is assumed to be a coefficient to the economic value of the ecosystem service (Costanza et al., 2017; Philips, 1998). Other experiments such as *contingent ranking, deliberate group valuation, and choice modeling* have emerged. The latter experimental approaches however pose major shortcomings. Jost and Ingo (2014) posit that valuations resulting from these methods are inconsistent and unreliable because: (1) valuations are context specific and depend largely on the personal situation of the interviewees, (2) results are largely dependent on the experience of the interviewer, and (3) the design of the experiments determines how well the values are captured.

**2.3 Emergence of private protected areas: global status, definition, benefits and downsides**

Dudley (2008, p. 26) define a PPA as "protected areas under individual, cooperative, NGO or corporate control and/or ownership, and managed under not-for-profit or for-profit schemes." Mitchell et al. (2018) adds that an area may only be recognized as a PPA if it meets the IUCN's definition of a protected area (see IUCN definition in section 2.1). The management of land or sea in PPAs are under the authority of the proprietors (Dudley, 2008). Decision such as conservation objectives; the creation of management plans; and its subsequent enforcement are only subject to state legislations—such as resource use regulations. Governments therefore under report the management of PPAs. Notwithstanding, the designation of PPAs has increased over the last decades.

As of January 2021, the WDPA reported 13,103 private protected areas (PPAs). This accounted for about 5% of the globally reported protected areas. North America accounts for 21.2% of the reported PPAs; followed by Africa with 11.8%; and, Latina America and the Caribbean with a similar proportion of 11.1% (Protected Planet, 2021). Most PPAs are owned by charitable trusts who receive funding from the public; for profit companies who operate ecotourism businesses;

philanthropic companies and organizations which manage areas important for wildlife refuge; religious institutions who set aside land for religious regions—such as sacred groves—and individuals who chose to invest in conservation (Mitchell et al., 2018; Pegas & Castley, 2014; Stolton et al., 2014). These figures are expected to increase as the role of PPAs in biodiversity conservation are being recognized and reported.

The increase in the designation of PPAs is primarily driven by the ineffective management of state established protected area, and the failure of states to meet conservation needs (Langholz & Krug, 2004). Institutional barriers such as the lack of legislations; insufficient public participation; underfunding (He & Cliquet, 2020), as well as increased human encroachment; habitat fragmentation and loss; wildfires; invasion by exotic species; and inconsistency of conservation policy implementation (Wondimagegn, 2020) are some examples of challenges faced by state managed protected areas. PPAs are thought to be more effective at addressing these issues. Child et al. (2013) report for example that management in PPAs is positively correlated with herbivore and predator density in the savanna biome of South Africa. Other scholars such as Mitchell et al. (2018) and Hora et al. (2018) argue that PPAs are important biological corridors. They claim that PPAs are located in areas where state protected areas are unlikely to be established (such as productive land), and therefore they bridge the spatial gaps between landscapes.

The increase in societal interest in conservation, as well as the boom in ecotourism has led to the surge of PPAs (Langholz & Krug, 2004). Pegas and Castles (2014) report that, interest in the preservation of the natural environment is the largest driver of PPA establishment in Brazil. Similarly, in the Eastern and Western Cape Provinces of South Africa, most PPA owners (83%) identified the protection of nature as the primary motivation for PPA establishment (Clements et al., 2016). The same authors report that between 81-92% of PPA owners had an interest in generating income from their lands. In extra ordinary cases such as the neoliberal private property rights movement in Chile, PPA designation for ecotourism and for-profit has been steadily increasing since 1973 (Hora, 2018). PPA such as the Pumalín Park in Southern Chile has promoted local development and revitalized the local economy of marginalized communities through ecotourism (ibid). Opportunities for the exploitation of timber resources, sale of non-timber forest products, as well real estate for residential homes are drivers for the creation of PPA (Stolton et al., 2014). Despite contributing to the conservation and development, PPA establishment has been met with several concerns and opposition.

Concerns over PPA can be categorized into ecological, economic and social. Keeping a PPA as a conservation site is largely dependent on ownership. This means that a PPA may stop being

a conservation site with a change of ownership, or with a change of mind (Stolton et al., 2014). In South Africa for example, more than 6.2% of PPA were degazetted between 1926 to 2018; 4% higher than state owned parks (De Vos et al., 2019). This tenuous status is aggravated by the fact that many PPAs are very small and may not be hosting viable populations (Langholz & Krug, 2004; Stolton et al., 2014). Yet, many PPAs which offer wildlife experiences—such as trophy hunting—have overstocked populations of wildlife (Langholz, 2010). Economic interests may be in conflict with ecological interests; resulting in the degradation of ecosystems and services. Child et al. (2013) for instance found that the presence of herbivores in the savanna biome of South Africa were lower where tourism lodges were present. Additionally, PPA may create rifts between local communities. Holmes (2012) and Hora et al. (2018) argue that emergence of philanthropism in the capitalist world, and the economic potential of PPA poses risks of green grabbing, especially in developing countries where lands are available. Land ownership therefore may be in the hands of affluent foreigners (Langholz & Krug, 2004). Another major criticism against PPA is the inappropriate exclusion, marginalization and expropriation of people (Stolton et al., 2014) who rely on natural resources.

The conservation values and shortcomings associated with PPA designation highlights the need for governments to recognize them as an important part of the state owned protected areas system (Holmes, 2012; Langholz, 2010; Langholz & Krug, 2004; Mitchell et al., 2018; Stolton et al., 2014). This should be coupled with policies and guidelines for governance (such as local inclusion), as well as enabling environments (economic support) for their long term sustainability and persistence.

### 2.4 Social ecological co-evolution: a conceptual Framework

The previous chapter has built on the concept of protected areas as complex SES. This is built on two major theories: the concept of social ecological resilience and social ecological co-evolution. Resilience as discussed in the previous chapter, refers to the ability of a system to adapt to the changing social and ecological conditions. Co-evolution in SES recognizes that ecological systems and social systems evolve mutually (Desjardins, 2019). Changes in social system—such as technology, knowledge and social organization—alters the biophysical environment; which in turn affects evolution in the social system (Kallis, 2007; Norgaard, 2009). The survival of both ecological and social systems is only possible if they are mutually beneficial to each other. This thesis tries to understand direct use values of the Golden Stream Corridor Preserve (GSCP) by utilizing social ecological co-evolution thinking as its conceptual framework.

The social ecological co-evolution is a useful framework for understanding the socioeconomic relevance of tropical forestry to rural development (Pretzsch et al., 2014). The conceptual framework guiding this research is primarily drawn from the co-evolution model developed by Pretzsch et al. (2014). The co-evolution model is relevant for this research because it encompasses the adaptive character necessary for forest management and forest oriented development in the tropics (Pretzsch et al., 2014); in this case protected areas. Citing work from Pretzsch et al. (2014), the model is composed of three major components. The first being the natural system; which refers to all biological and biophysical functions and interactions (Costanza et al., 2017). The second component is the social system which represents user/user groups (Ostrom, 2009) and their pattern of resource use. Bridging the afore mentioned systems is the management interface which includes all formal and informal rules of resource use.

The Co-evolution model has been modified to fit the local context of the single case embedded case study (Figure 3). **Composite I** represents the forests, freshwater, land and biodiversity of the GSCP; the mosaic of several protected areas surrounding it; as well community forests, lands and settlements. This landscape facilitates the supply of provisioning, regulating, supporting and cultural services and values. However, the object of analysis in this research is ecological system of the GSCP. The interface of the GSCP's social and ecological systems is represented in **complex II**. The first component of this interface is the management strategies implemented by the Ya'axché Conservation Trust (here after referred to as Ya'axché); a non-governmental organization responsible for the management of the GSCP. Management by Ya'axché is achieved under 8 programs; *compliance* and enforcement through joint patrols; *education and outreach* at local, regional and national level*; biomonitoring and research* in the GSCP and other co-managed PAs; *climate smart farming programs* and extension services to local communities; *capacity building and training* programs for farmers and local groups; *advocacy* programs; development and promotion of *ecotourism* activities within the GSCP and surrounding communities; and state of the art *land use change monitoring*. As a consequence of management, and ecological processes, several use and nonuse values are generated. The use and exploitation of these use values creates a feedback loop which directly impacts the condition within the ecological system of the GSCP. Focus in this research is drawn only to the quantification and valuation of direct use values of the GSCP to local communities (highlighted and italicized in figure 3.1). An additional component under analysis in this study are other non-monetary benefits arising from the management of the GSCP. These benefits are directly linked to the implementation of management strategies within the GSCP. A third important part of the management interface is the traditional use of land and exploitation of resources by

communities. This relates to the informal rules set by communities to oversee the management of land and forest resources.

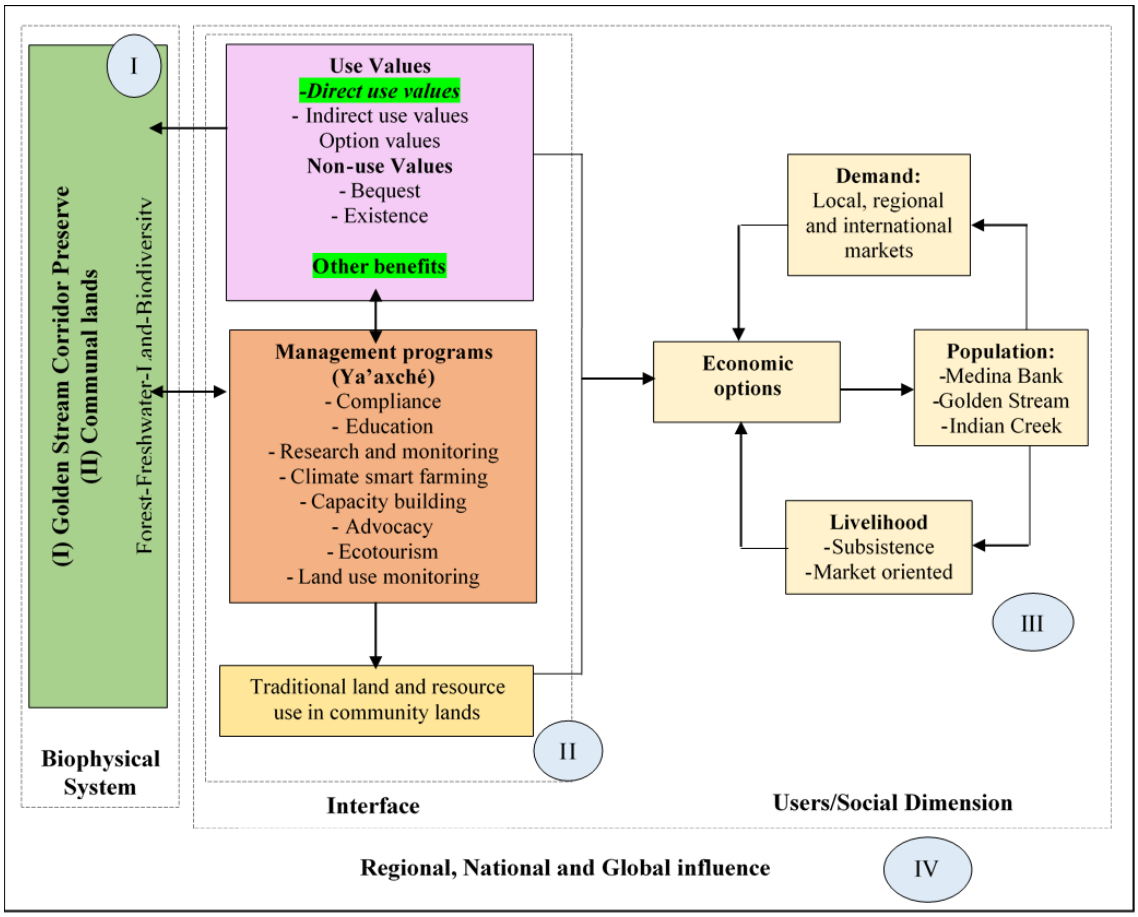



Figure 3 Conceptual framework understanding the utilization of direct use values and the management effectiveness of the Golden Stream Corridor Preserve (adapted from Pretzsch et al. 2014).

The social system of the SES under analysis is represented in **complex III**. As a direct result of the management of the natural capital within the GSCP, and adherence to informal traditional rules relating to resource use and exploitation in the communities, *economic options* are created. These economic options are available to *populations* immediately adjacent to the GSCP. Populations in this research refers to: Medina Bank, Golden Stream, and Indian Creek. These communities are of Mayan descent, and therefore the consumptive and cultivation patterns of these communities are a result of thousands of years of societal and cultural co-evolution with the natural environment. In these communities, *consumptive patterns* are both subsistence use and market oriented. The last faucet of the social dimension are the local, regional and international *market demands*. These demands directly contribute to the generation of economic opportunities such as income generation from surplus agricultural products, cultural tourism and the production of sustainably produced agroforestry crops.

The complex and interconnectedness of the GSCP's cannot be discussed independent of national, regional, and global context (Composite IV). This arena is dominated by formal institutions such as protected area legislations in Belize; policies such as the National Protected Areas System Plan; governmental departments; non-governmental coalitions; international conventions; international organizations; and donor groups.

# CHAPTER THREE

## 3. Site description, research design and methods

### 3.1 National Context: protected areas in Belize

The designation of protected areas in Belize is linked to its British-logging colonial history (Young & Horwich, 2007). The first extractive forest reserves were established in 1920 by the colonial government (Hartshorn, 1984). As, the first conservation oriented protected area Half Moon Caye was not established until 1928 (Mitchell et al., 2017). In 1981 when Belize obtained its independence, the passing of the National Parks Act resulted in the exponential establishment of protected areas (Young & Horwich, 2007). The latest protected area report by Salas and Shal (2015) recognizes 103 protected areas in Belize (Figure 4); although the World Database on Protected Areas (WDPA) reports that Belize has 120 protected areas. This represents protection of 37.55% of Belize's terrestrial ecosystems, and 11.02% of territorial waters (UNEP-WCMC, 2021). Belize is one of the few countries which has achieved, and even surpassed the Aichi Target 11 of the CBD (Mitchell et al., 2017). These protected areas make up what is known today at the National Protected Areas System (NPAS).

Protected areas in the NPAS are classified into 13 management categories (See Box 1 for definitions). The NPAS is overseen by the Belize Forest Department, Belize Fisheries Department, and the National Institute of Culture and History. Marine reserves and spawning aggregations are under the oversight of the Fisheries Department; national parks, forest reserves, nature reserves, and wildlife reserves are under the direction of the Forest Department; and all archaeological reserves are managed by the National Institute of Culture and History (Williams & Tai, 2016). Even though ninety four percent of the NPAS belongs to the state (Mitchell et al., 2017), only a small portion (22%) is directly managed by the aforementioned governmental departments. Three additional management regimes are recognized in Belize: joint governance (co-management), private governance, and community governance.

At least 38% of protected areas in Belize are managed under co-management agreements between the Government of Belize and NGOs, community based organizations and other forms of organizations (Mitchell et al., 2017). Co-management agreements allow managing entities to use biological resources in the area; occupy portions of the area; develop economic opportunities within and around the area; develop local capacity; and attain financial sustainability (National Protected Areas System Act, 2015). Private governance has become one of the most recent recognized management regime in Belize. Currently, only 6 private protected areas have been recognized by the Government of Belize (Mitchell et al., 2017). The governance of PPAs is exclusively the responsibility of the proprietors. Community governance

is comparable to private governance because responsibility and management of resources belongs to indigenous communities or local communities who hold legal rights to these land (Salas & Shal, 2015). The distinction between community governance is unclear because several indigenous communities also have co-management agreements with the government of Belize. According to Mitchell et al. (2017) at least twelve community based management exists in Belize.

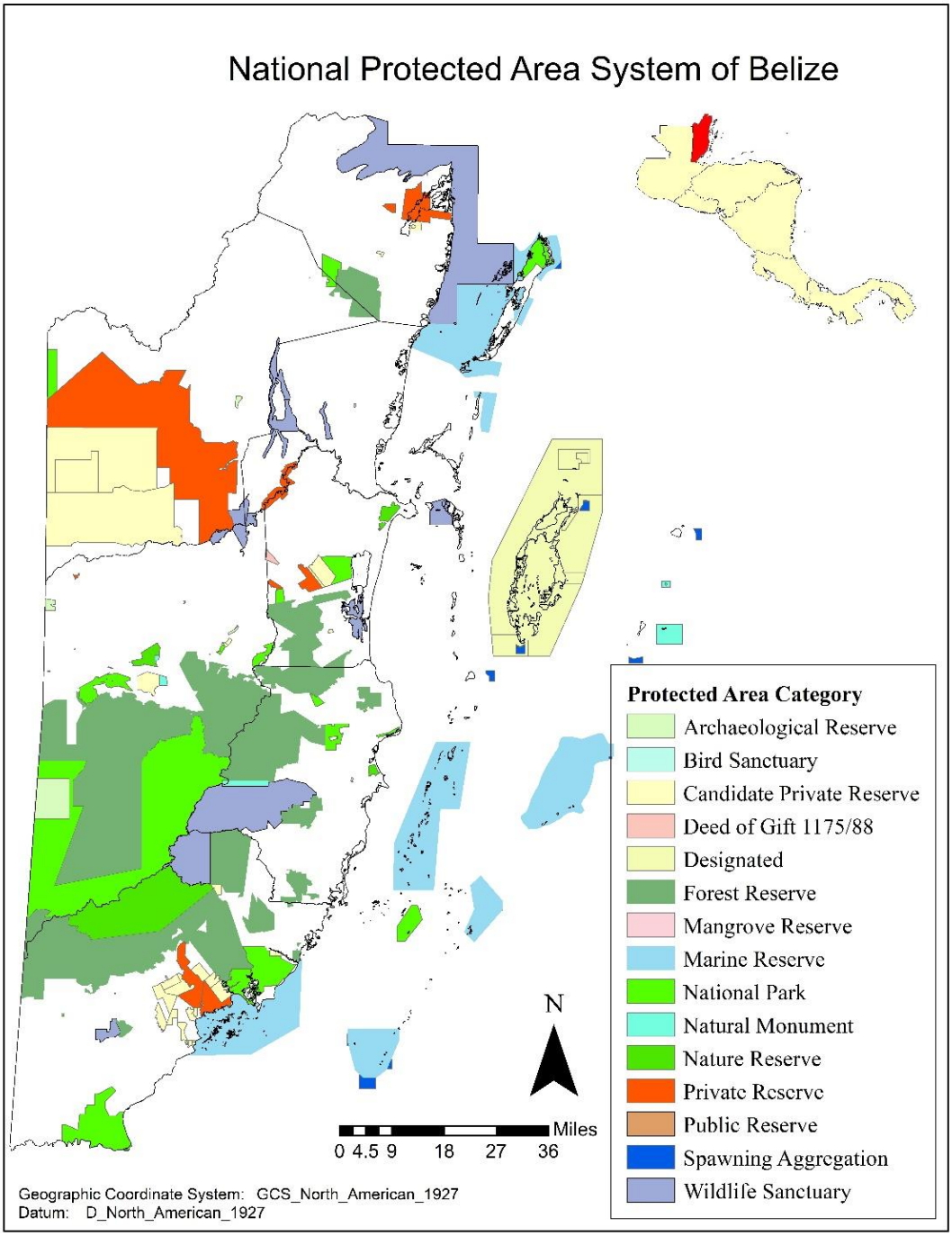



Figure 4: National Protected Areas System of Belize, in the inset, location of Belize in Central America (Source: created by author).

**Box 1**: Categories and definitions of protected areas in Belize.

**National park**: an area reserved for the protection and preservation of natural and scenic values of a national significance for the benefit and enjoyment of the general public
**Nature reserve**: means any area reserved as a scientific reserve for the protection of nature, be it biological communities or species and to maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, monitoring, education and the maintenance of genetic resources
**Wildlife sanctuary 1**: means any area reserved as a nature reserve for the protection of nationally significant species, groups of species, biotic communities or physical features of the environment requiring specific human manipulation for their perpetuation
**Wildlife sanctuary 2**: similar to wildlife sanctuary 1, except that established traditional community use, including harvesting on the basis of a sustainable use plan, is permitted.
**Natural monument**: means any area reserved for the protection and preservation of nationally significant natural features of special interest or unique characteristics to provide opportunities for interpretation, education, research and public appreciation.
**Forest reserve:** an area declared under protection for the exploitation of forest produce including:
(a) timber, lumber, firewood, charcoal, bark, extracts of bark (b) chicle, rubber and other latex, gums, resins, turpentine spices, tanstuffs, dyestuffs, drugs, leaves, fibres, thatching material derived from wild-growing trees or plants (c) trees, plants, dead or alive, and all parts and produce of such trees and plants, grasses; (d) wild animals, dead or alive, products of wild animals such as skins, shells, tusks, horns, bones, silk, cocoons, shellac, honey, wax, and all other parts and produce of wild animals; (e) soil, peat, rock, sand, coral and such products of mines and quarries when found in or brought from a forest reserve
**Marine reserve:** An area within the fishing limits of Belize protected for the purpose of:
(a) affording special protection to the aquatic flora and fauna of such areas and to protect and preserve the natural breeding grounds and habitats of aquatic life (b) allowing the natural regeneration of aquatic life in areas where such life has been depleted (c) promoting scientific study and research in respect of such area (d) preserving and enhancing the natural beauty of such areas.
**Archaeological reserve:** an area reserved for the protection of ancient monuments (any structure or building erected by man or any natural feature transformed or worked by man, or the remains or any part) whether upon any land or in any river, stream or watercourse or under the territorial waters of Belize, which has been in existence for one hundred years or more.
**Private protected area:** private land or sea declared as a protected area under the National Protected Areas System Act
**Protected landscape and protected seascape**: an area declared as a protected landscape or an area declared as a protected seascape, because of:
(a) physical elements of landforms, such as mountains and hills, water bodies such as rivers, lakes, ponds and the sea; (b) living elements of land including indigenous vegetation (c) human elements including different forms of land use (d) transitory elements such as lighting and weather conditions (e) the scientific study of these landforms and the processes that shape them
**Spawning aggregations**: an area recognized as an important site where important aquatic and terrestrial species of animals congregate to engage in reproductive activities.
**Special management area:** means an area so declared for the protection of biological corridors, critical nesting, roosting or congregation areas requiring active management
**Scenic landscape or of geomorphic significance**: an area declared under protection for the preservation of pleasing views of the natural features of an area of land

Compiled and sourced from The National Protected Areas System Act (2015), Natural Institute of Culture and History Act (2000), Fisheries Act (2000), and Forest Act (2000)

### 3.2 Local context: The Golden Stream Corridor Preserve

The Golden Stream Corridor Preserve (GSCP) is a private protected area located in the Toledo District in Southern Belize (Figure 5). The GSCP falls under Category VI (protected area with sustainable use of natural resources) of the IUCN's protected area classification system. The GSCP is bordered to the north by the Colombia River Forest Reserve; to the east by privately

owned protected areas managed by the Toledo Institute for Development and Environment (block 123 and 127); and to the west by the Boden Creek Ecological Preserve (Figure 5). Three buffering communities can be found around the GSCP, namely: Golden Stream Village, Medina Bank Village, and Indian Creek Village. The Thomas Vincent Ramos Highway dissects the northern part of GSCP. The GSCP is dubbed the last link to the Mesoamerican Biological Corridor PAs because it connects protected areas in the Maya Mountains of southern Belize to the Caribbean Sea.

The GSCP was established in 1998 when Flora and Fauna International (FFI) purchased 9,554 acres (or 3,866.4 hectares) of privately owned land. This came as a an initiative for protecting the Golden Stream watershed from impeding logging, shrimp farming, agriculture and expansion of orange orchards in southern Belize (De Vries et al., 2003). The GSCP was purchased after coordination with local conservation organizations, community leaders and the FFI. The land was placed under a Trust agreement with the government of Belize, and management was delegated to the Ya'axche Conservation Trust. Today, the GSCP makes up 6,248.8 of the 31,160.8 hectares Maya Golden Landscape (MLG) (Ya'axché Conservation Trust, 2019c). The MGL is a network of PAs, private lands, communal lands, as well as Mayan and Hispanic settlement (Figure 6).

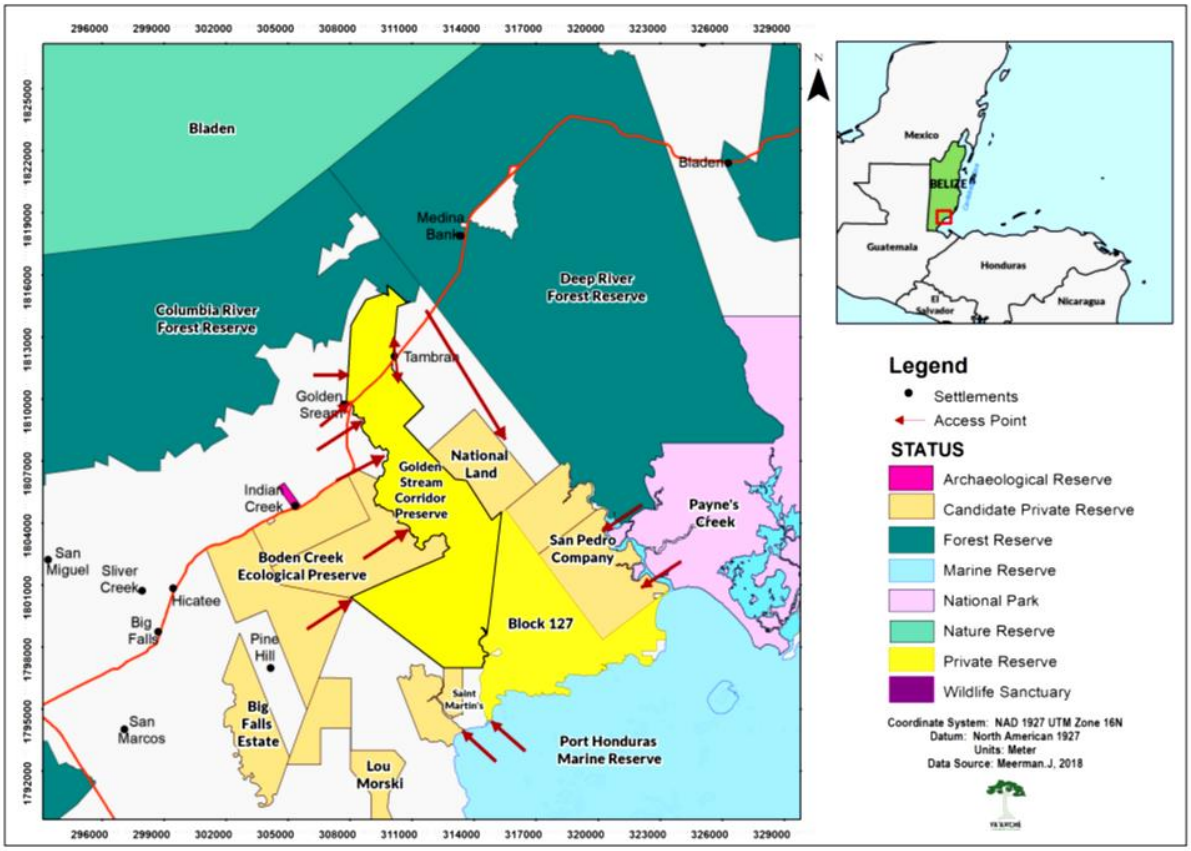



Figure 5: Location of the Golden Stream Corridor Preserve in the Toledo District, Belize (Source: Ya'axché, 2019)

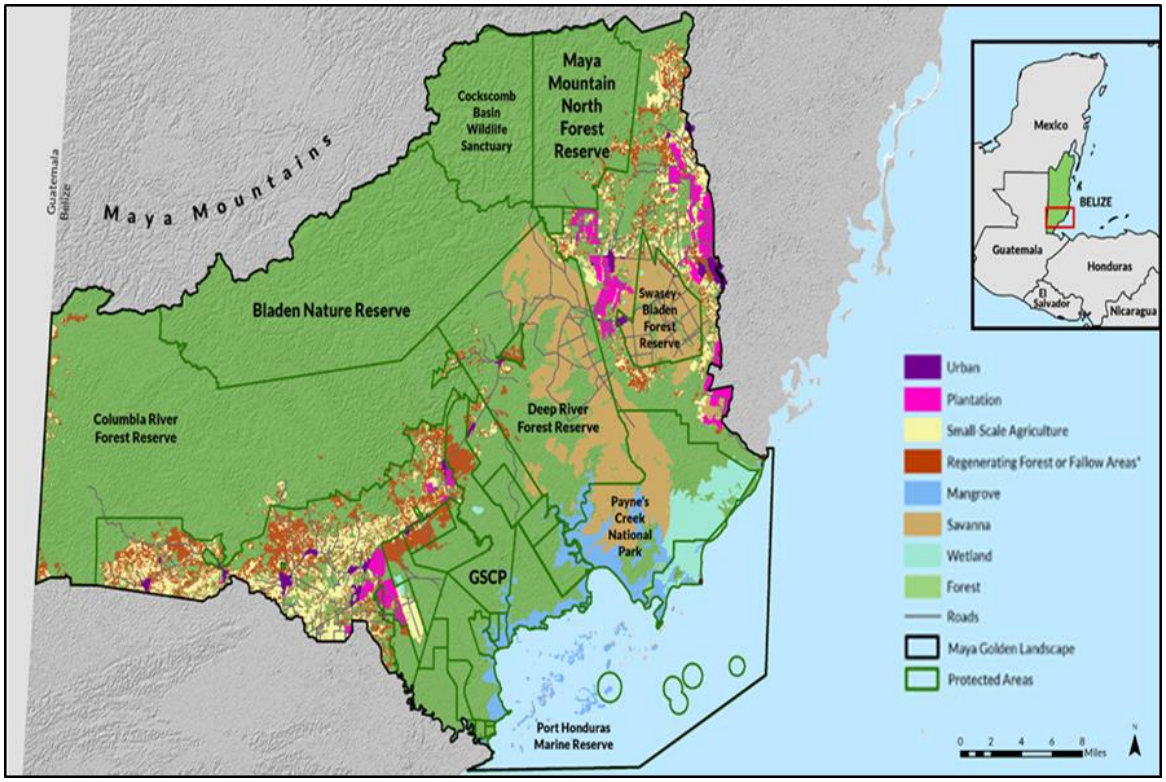



Figure 6: Location of the Golden Stream Corridor Preserve (GSCP) within the Maya Golden Landscape (Source: Ya'axché, 2019).

### 3.2.1 Management zones of the GSCP

The GSCP is managed under five management zones (Figure 7). The general use zone (zone 1) is dedicated for the day to day operation of field activities at the preserve. The Ya'axché Field Station can be found in this zone. The field station serves as an administration building and housing site for the ranger team. The Ecotourism Belize bunkhouse which offers lodging to tourist, students and researchers is also found at this field station. The Ya'axché nursery can also be found in the general use zone. Timber species, fruit trees and agroforestry species such as cacao and coffee are grown in the nursery. A fire lookout and observation tower is also found in the premises of the field station. Zone 2 is dedicated for recreation, education, tourism and environmental interpretation. A network of trails can be found in this zone. Zone 3 is dedicated for the sustainable harvesting of forest material. These zones are located immediately adjacent to buffering communities: Tambran and Golden stream villages. Forest material—such as palm fronds—can be collected by community members and Ya'axché staff in this zone. Community members given access to resources free of cost through a permitting process which can be applied at the field station. Mayan communities are allowed to conduct non-extractive cultural and spiritual activities in zone 4. Most of the GSCP territory is dedicated to for preservation (zone 5). This area is strictly dedicated to conservation, research and bee keeping.

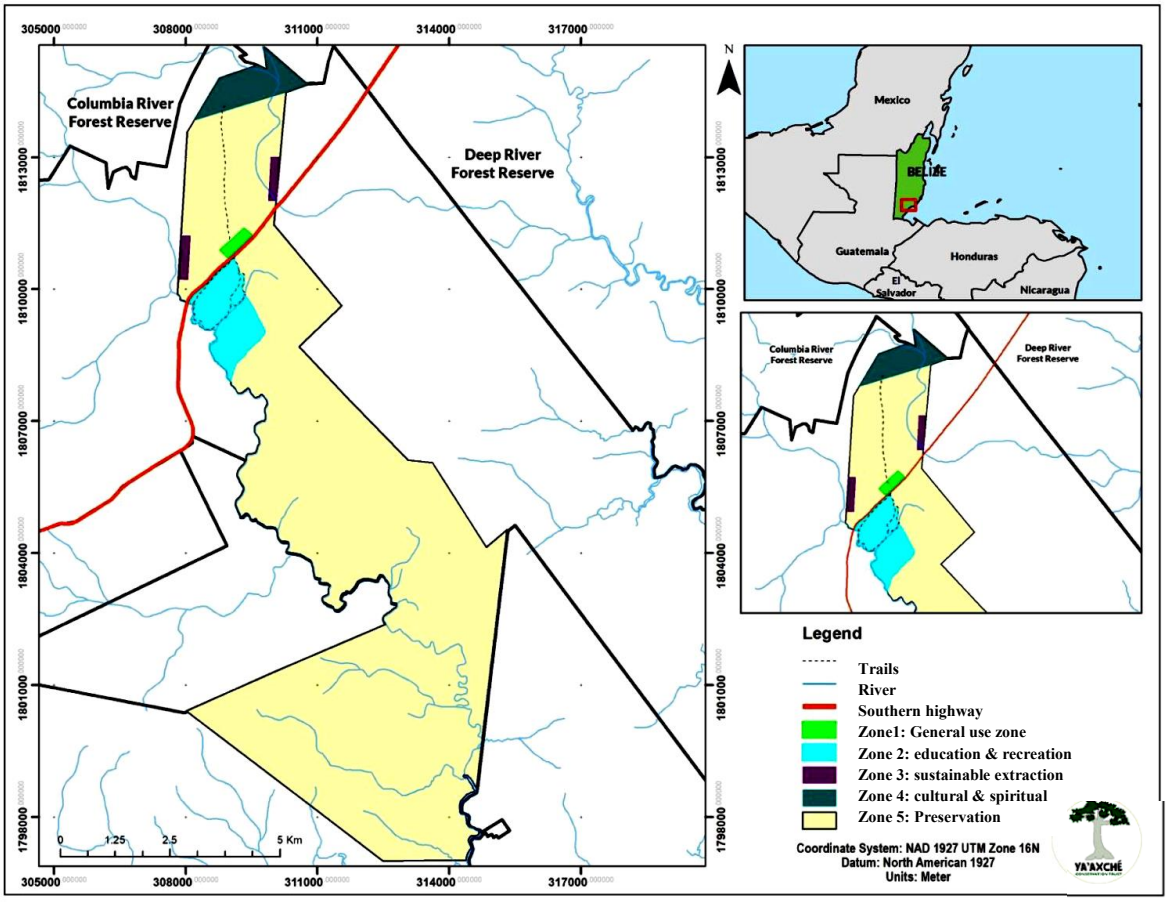



Figure 7: Management zones of the Golden Stream Corridor Preserve (Source: Ya'axché, 2019)

### 3.2.2 Management organization: Ya'axché Conservation Trust

The GSCP has been under non-governmental management since its inception in 1998. Ya'axché is governed by a board of directors which consists of appointed members (7-9), community representatives and special members who may have an interest or may be invited to join the board. Ya'axché co-manages two additional PAs; the Bladen Nature Reserve, and the Maya Mountain North Forest Reserve.

The mission of Ya'axché is to "maintain a healthy environment with empowered communities by fostering sustainable livelihoods, protected area management biodiversity conservation and environmental education within the MGL" (Ya'axché Conservation Trust, 2019b, p. 53). This mission accomplished by implementing six management programs: (1) compliance; (2) land use monitoring; (3) research and monitoring; (4) climate smart farming; (5) education, community outreach and advocacy, capacity building; and (6) ecotourism. Under the compliance program Ya'axhé's ranger team conducts patrols, as well as joint patrols with the Belize Defense Force, the Belize Police Department. The land use monitoring program facilitates the detect and track land use change within and around the GSCP with GIS and GPS

technology. Under the research and monitoring program Ya'axché conducts routine bird and large mammal monitoring, as well as tree and plant monitoring. This program is executed by a resident science director, ranger teams as well as volunteer researchers. The climate smart farming promotes environmentally friendly farming techniques such as inga alley cropping, apiculture, slash and mulch, as well as coffee and cacao agroforestry at local communities in the MGL. Under this program Ya'axché also provides farming extension services to communities buffering the GSCP and within the MGL. Education, community outreach and advocacy programs facilitates the promotion of Ya'axché's work. Under this program several summer camps are held at the field station. More than 250 primary school children are also engaged in the discussion of environmental problems. Outreach and advocacy exercises are routinely held on radio and television shows, as well as social media platforms and formal publications. The capacity building program trains local communities in the development of leadership skills, fire management, environmental management, small business development, marketing, and financial management. The ecotourism program is the business arm of Ya'axché. EcoTourism Belize; a tourism agency, was adopted in 2015. The agency provides tours, educational tours, and tour packages to local and international tourists. EcoTourism Belize also contributes to local communities by promoting cultural experiences, arts and crafts and catering provided by local women's group.

### 3.3 Case study approach

According to Yin (2009), a case study approach in research is relevant when a researcher seeks to answer explanatory questions—how and why—or to describe a phenomenon. Djamba and Neuman (2002) define a case study as "research that is an in-depth examination of an extensive amount of information about very few units or cases for one period or across multiple periods of time" (p. 32). Yin adds that case studies may be exploratory, descriptive or explanatory. Exploratory approach undertaken when the subject in question is new, or very little is known about it; descriptive research presents a picture of a situation, social setting or relationship; explanatory research on the other hand, tries to establish a cause-effect relationship by answering *why* questions (Djamba & Neuman, 2002). This thesis undertakes both an exploratory and a descriptive approach to analyze the phenomenon—direct use values and benefits—that surrounds the case study site by using a mixed method survey.

An important component of case study research design is to define the unit/s of analysis. "Units of analysis" refers to the entities or objects in a case which are being studied (Adolphus, 2021). In case study designs, there are four major possible arrangements for analyzing the contextual conditions of a "case" (Yin, 2009). According to Yin (2009) and Adolphus (2021) a single-case

(holistic) design (Type1) consists of one single case study and *one unit* of analysis; single-case (embedded) design (Type 2) also analyses one single case, but has multiple *embedded* units of analysis; multiple-case (holistic) design (Type 3) analyses one unit of analysis in multiple case studies; multiple-case (embedded) (Type 4) on the other hand examines multiple embedded units of analysis across multiple cases. This research follows a single-case (*embedded*) design to tackle research questions and objectives.

### 3.3.1 Embedded case study: The Golden Stream Corridor Preserve

This thesis combines the benefits of undertaking an exploratory approach to research and case study design to provide insight into the direct use values and benefits of the GSCP. The enumeration of quantitative data is complemented by observations, anecdotes, and qualitative data. The exploratory approach is centered around a single-case (embedded) design illustrated in Figure 8.

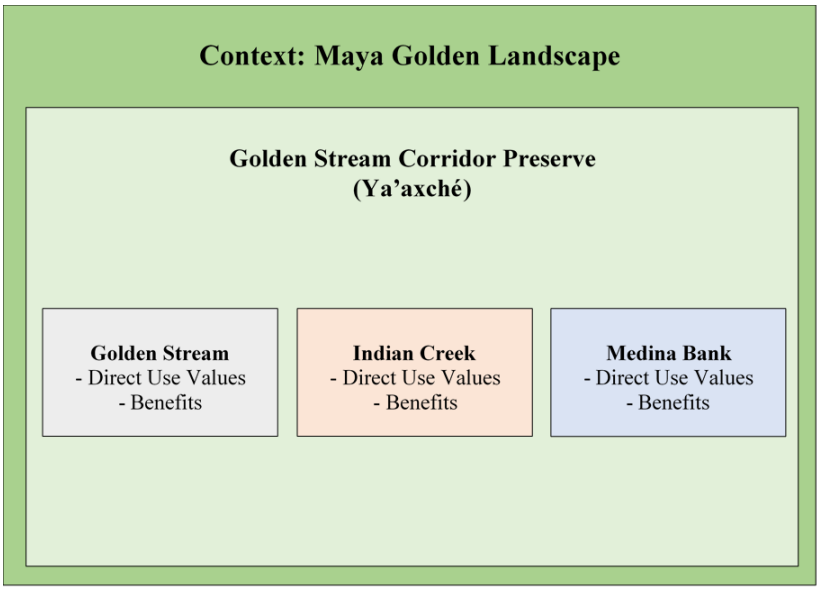



Figure 8: Schematic of the single-case (embedded) design of the research.

The context of this single-case embedded design is the Maya Golden Landscape (MGL). The GSCP is one of the nine protected areas in this landscape. It is managed by Ya'axché along with 2 other protected areas: The Bladen Nature Reserve, and The Maya Mountain North Forest Reserve. Over nineteen communities adjacent to these protected areas receive direct and indirect benefits through the generation of use and non-use values. Given this complexity, a single-case was selected: the GSCP. For the GSCP case study, three units of analysis were identified. The units of analysis are the three villages located immediately adjacent to the GSCP: Golden Stream, Medina Bank, and Indian Creek villages. Golden Stream Village is located on the northwestern border of the GSCP. Medina Bank village is located about 9 kilometers northeast of the GSCP. Indian Creek is located about 10 kilometers west-northwest

of the GSCP. These villages have been historically considered to be the primary buffering communities of the GSCP (De Vries et al., 2003). Within the aforementioned units of analysis, the objects of propositions are the direct use values and benefits derived from the management of the GSCP.

### 3.4 Data collection

#### 3.4.1 Formal introduction to community leaders

All villages within this research were Mayan communities. Each community has 2 leaders; an *Alcalde* and a Chairperson. The *Alcalde* is a traditional leader who is elected by the community members to oversee the rule of customary laws within the community. An *Alcalde* is elected every 2 years. The Chairperson on the other hand is the "political representative" of the community. The chairman is elected during national village council elections held every 3 years. Prior to conducting data collection at study sites, the researcher was introduced to community leaders by the community liaison personnel from Ya'axché. Each community leader was met separately (due to unavailability and distance from each other), the researcher outlined the general and specific objectives of the research; the importance for conducting such research; and the sample size in each community. A formal letter of request was provided to each community leader during these meetings.

Consent to conduct research at Medina Bank was granted immediately. At Golden Stream, a second meeting was scheduled at a later date with both leaders present. During this meeting details of the research and how possible outcomes of the research can benefit the community were discussed. At Indian Creek, consent was granted at a separate date after both community leaders met. Indian Creek leaders subsequently met with several community representatives to discuss the research interest. During this meeting, it was determined that the village leaders would provide a list of potential interviewee households. Community leaders took this approach to increase the representativeness of community members and community groups. This proved helpful since Indian Creek has the largest population in this study and spans about 4 kilometers along the main highway.

#### 3.4.2 Data collection strategies

Quantitative and qualitative data collection techniques were used to gather information on the case study. The quantitative method focused on determining the direct use values of the GSCP. This was accomplished by using a semi-structured questionnaire (see Annex 1) to interview household leader/s. A portion of the questionnaire also gathered qualitative data by recording the experience, opinions, and additional feedback of household leaders about the management

of the GSCP. Direct observations were also conducted. Information was complemented with an interview with community leaders.

**Direct observation**

Direct observations are accomplished by documenting real events, recording/listening to what people say, observing the environment and noticing behaviors (Djamba & Neuman, 2002). After community leaders agreed to allow data collection in the community, the researcher scouted the community to have an idea of the natural and social environment; the distribution of households within each community; special landscape features; as well as the infrastructure within the communities. Using this information, community maps were sketched to facilitate the selection of households for interview. Observations were also used to create a description for each community.

**Community leader interview**

A semi structured interview was conducted with the community leaders to gather information about communities (see Annex 2). The interview focused on understanding the customary resource use rules that exist within each community; the social arrangement; and the history of the community. From each community, the first available village leader was interviewed (either the *Alcalde* or the chairperson). Only one village leader from each community was interviewed because the information possessed by both community leaders was determined to be uniform.

**Household interviews**

Household sampling for each of the communities was guided by the latest census in Belize (2010), in which the Statistical Institute of Belize (SIB) reported that Indian Creek had a population of 722, and 135 households. Golden stream had 52 households, and a population of 394. Medina Bank on the other hand had only 34 households and a population of only 237. The SIB (2010) reports that the Belizean population experiences an annual growth rate of 2.65%. Using this information, an extrapolation of the estimated current population size and number of households at each community was made (Table 1). The number of households to be interviewed for each community (10%) was deliberated from the estimated current number of households. Although this method overestimated community population and number of household (determined after interviewing community leaders), the predetermined sample was kept to strengthen data validity.

In survey research, a standardized questionnaire or a formal interview is used to gather data. Random sample selection is preferred since it allows valid generalization of information from a small sample to a larger population (Djamba & Neuman, 2002). To measure the direct use values of the GSCP, a semi-structured mixed method survey instrument (see Annex 1) was used

to interview households in study communities. A total of 60 households, representing ten percent (10%) of the estimated number of households in each community were interviewed. At Medina Bank and Golden Stream, 10% of households were randomly selected using a community map. At Indian Creek Village, the Community leaders created a list of potential individuals/households for interviews. This list also represented 10% of the estimated households at Indian Creek. Data collection lasted between June and August of 2020.

Table 1: Sample size based on the estimated population growth of Golden Stream, Medina Bank and Indian Creek using a growth rate of 2.65% per year.

| **Community** | **Population (2010)** | **Households (2010)** | **Estimated population (2020)** | **Estimated # of household (2020)** | **Sample proportion (10% households)** |
|---|---|---|---|---|---|
| Golden Stream | 349 | 52 | 925 | 138 | **15** |
| Medina Bank | 237 | 34 | 628 | 90 | **09** |
| Indian Creek | 722 | 135 | 1913 | 358 | **36** |
| **TOTAL** | | | | | **60** |

Questionnaire pilot testing is the first step in survey research (Djamba & Neuman, 2002). Pilot testing helps to identify problems with the framing of questions; such as biased wording, unnecessary variables, determining whether format is user friendly (length and layout), and if choices (for close ended questions) or scales are appropriate (Thomas, 2004). A pilot questionnaire was conducted at all communities. Two households in each community were randomly selected and interviewed. The survey instrument was subsequently edited and produced. Data gathered during the questionnaire pilot was not used during the analysis process. During the pilot phase, it was discovered that household interviews took between an hour and an hour and a half. Because of the length of the interview, selected households were visited at least one week prior to interview. A convenient date and time of interview was determined. This increased data accuracy and prevented inopportune timing of interview. Household interviews had to be cut short in early August due to the second outbreak of Covid-19 in Belize. In order to have a representative sample, 5 final interviews were conducted via telephone; 3 at Golden Stream and 2 at Medina Bank.

### 3.4.3 Measuring direct use values: variables

The survey instrument collected data around seven major variable categories: household demographics; household assets; forest utilization; income from crops; income dependent on the GSCP; other source of income; and benefits received from Ya'axché. Households were also given an opportunity to express their comments, feedback and concerns about the management

of the GSCP at the end of the interview (Table 2). While the focus of this thesis is to measure the direct use values arising from the management of the GSCP, collecting data from all the afore mentioned variable facilitates the attribution of which and how much direct use values and benefits arise directly from the management of the GSCP. Selection of these variables was guided by those used by Aung (2012), and also from literature review.

Table 2: Summary of variables, sub variables and scale of measurement gathered by semi structured questionnaire.

| Main variable | Sub-variables | Scale of measurement |
|---|---|---|
| **Household demographics** | Age | Years |
| | Education | Primary education, secondary, tertiary, graduate; incomplete |
| | Occupation | Open ended |
| | Household size | Numerical |
| | # of adults | Numerical |
| | Ethnicity | Kekchi Maya, Mopan Maya, Mestizo, Creole, Hispanic |
| **Household assets** | Land size | Acres |
| | Area cultivated | Acres |
| | Area of follow land | Acres |
| | Area of forested land | Acres |
| | Land Ownership | Leased, communal |
| **Forest utilization** | Construction material | Source: GSCP, Communal lands, Quantity extracted. |
| | Fuel wood | Source: GSCP, Communal lands, Quantity extracted. |
| | Edible forest products | Source: GSCP, Communal lands, Quantity extracted. |
| | Medicinal plants | Source: GSCP, Communal lands, Quantity extracted. |
| | Bush meat | Source: GSCP, Communal lands, Quantity extracted. |
| | Other non-timber forest products | Source: GSCP, Communal lands, Quantity extracted. |
| **Income from Agriculture** | Agricultural crops | Quantity produced, quantity used, quantity sold. |
| | Livestock | Quantity produced, quantity used, quantity sold. |
| | Bee keeping | Quantity produced, quantity used, quantity sold. |
| | Agroforestry | Quantity produced, quantity used, quantity sold. |
| **Income dependent on the GSCP** | Income from direct employment | Annual salary (Belize dollars) |
| | Income dependent from on the GSCP | Annual contribution to household income (Belize dollars) |
| **Offsite income** | Type of income generating activity | Annual salary (Belize dollars) |
| **Benefits received from Ya'axché** | Extension services | Qualitative feed back |
| | Training | Qualitative feed back |
| | Other benefits | Qualitative feed back |
| **Comments** | Feedback on management of the GSCP | Qualitative feedback |

### 3.5 Data analysis

#### 3.5.1 Determining and comparing direct use values of the GSCP

**Calculating income from forest utilization**

In this case study, forest utilization generated two forms of income: subsistence income and cash income. These forms of income came from the collection of construction material; gathering of edible plant products; hunting of bush meat; collection of fuel wood; collection of medicinal plants; and the collection of other NTFPs. In order to determine the direct use values directly associated with the GSCP, the sources of the forest products were determined during household interviews. The quantities and of each forest product collected was recorder. The local market price of forest material was also recorded. Local market prices were preferred because they reflect the true opportunity cost (value) of households who utilize the forest products (Luckert & Campbell, 2012). Direct use values were calculated in the following manner:

$$I_F = \sum FI_{GSCP} + FI_{CF}$$

Where:

$$FI_{GSCP} = GSCP_{(cash)} + GSCP_{(sub)}$$

$$FI_{CF} = CF_{(cash)} + CF_{(sub)}$$

$I_F$: forest direct use values

$FI_{GSCP}$: forest income dependent on the GSCP

$FI_{CF}$: forest income dependent on community forests

$GSCP_{(cash)}$: cash income from forest products originating from the GSCP

$GSCP_{(sub)}$: subsistence income from forest products originating from the GSCP

$CF_{(cash)}$: cash income from forest products originating from community forest

$CF_{(sub)}$: subsistence income from forest products originating from community forest

**Calculating income dependent on GSCP**

The income of households which depended on the GSCP was determined from the annual salary of household members who were employed at the GSCP, and income generating activities associated with the GSCP. This was addressed in the following manner:

$$I_{GSCP} = \sum GSCP_{(emp)} + GSCP_{(assoc)}$$

Where:

$I_{GSCP}$: direct use values dependent on the GSCP

$GSCP_{(emp)}$: annual salary from employment at the GSCP

$GSCP_{(assoc)}$: annual income associated with the GSCP

**Calculating income from agriculture**

Households generated cash and subsistence income from agriculture practices. These incomes were comprised of the cultivation of crops at *Milpas* (farms), rearing of livestock, bee keeping, and the production of agroforestry products. Income from agriculture was calculated from the reported agricultural yields in the last year and the local market price of agricultural product. According to Vedeld et al. (2004), gross (environmental) income directly or indirectly accounts for capital costs, cost of intermediate inputs, labor costs, normal profits, and rent. In this case study however, income from agriculture is only reported as gross income. This approach is justified following assumptions presented by Sjaastad et al. (2005) and Vedeld et al. (2004); first, rural markets are characterized by informality (imperfections) which results in insignificant normal profit and rent calculations; second, gross value may be a proper representation of income when capital costs and intermediate incomes are trivial (as is the case for subsistence farming); third, opportunity costs for employment in rural settings are difficult to ascertain; and finally, ascertaining actual capital costs, cost of intermediate inputs, labor costs, normal profits, and rent is time consuming and may require different economic approaches (see Chapter 7). Gross income from agriculture was therefore determined in the following manner:

$$I_{Ag} = \sum Ag_{(cash)} + Ag_{(sub)}$$

Where:

$$Ag_{(cash)} = \sum M_{(cash)} + Bk_{(cash)} + Ls_{(cash)} + Af_{(cash)}$$

$$Ag_{(sub)} = \sum M_{(sub)} + Bk_{(sub)} + Ls_{(sub)} + Af_{(sub)}$$

$I_{Ag}$: income from agriculture

$Ag_{(cash)}$: Cash income from agriculture

$Ag_{(sub)}$: Subsistence income from agriculture

$M_{(cash)}$: cash income from *Milpa* produce

$M_{(sub)}$: subsistence income from *Milpa* produce

$Ls_{(cash)}$: cash income from livestock

$Ls_{(sub)}$: subsistence income from livestock

$Bk_{(cash)}$: cash income from bee keeping

$Bk_{(sub)}$: cash income from bee keeping

$Af_{(cash)}$: cash income from agroforestry

$Af_{(sub)}$: subsistence income from agroforestry

**Calculating other sources of income**

Besides the extraction of forest material and production in agriculture, households had offsite employment and conducted other income generating activities. The sum of these 'offsite' incomes were calculated in the following method:

$$I_{offsite} = \sum E + Ia$$

Where:

$$E = E_1 + E_2 + \ldots E_x$$

$$Ia = Ia_1 + Ia_2 + \ldots Ia_x$$

E: gross household salary

Ia: gross household income from income generating activities

$E_1$: annual salary from employment 1

$E_2$: annual salary from employment 2

$E_x$: annual salary from employment x

$Ia_1$: annual income from other income generating activity 1

$Ia_2$: annual income from other income generating activity 2

$Ia_x$: annual income from other income generating activity x

The calculation of these forms of incomes were executed in order to have a comprehensive understanding of the incomes of households, and how the direct use values associated with the GSCP relates to these. These incomes were calculated for each community within the single case embedded case study.

**Statistical methods**

While Yin (2009) contends that the purpose of case study design in research to expand theories and not to find statistical significances and enumerate frequencies, statistical methods were employed in this thesis. The main purpose of statistical methods in this research was to determine trends; discover relationships between variable; and make comparisons between the units of analysis (communities). Statistical methods described in Table 3. were executed using IBM SPSS Statistics 23 package.

Table 3: Statistical analysis executed to answer research questions.

| Research question | Variables | Statistical method |
|---|---|---|
| What resources do the communities extract from the GSCP? | $FI_{GSCP}$<br>$FI_{CF}$ | Descriptive statistics |
| How do resource use differ from community to community? | $FI_{GSCP}$, $FI_{CF}$ (MB)<br>$FI_{GSCP}$, $FI_{CF}$ (GS)<br>$FI_{GSCP}$, $FI_{CF}$ (IC) | -Descriptive statistic<br>-non-parametric Kruskal-wallis test |
| What are the market value of these goods? | $FI_{GSCP}$, $FI_{CF}$ | Descriptive statistics |
| How much of the household's income/livelihood is dependent on the GSCP? | $I_F$<br>$I_{GSCP}$<br>$I_{Ag}$<br>$I_{offsite}$ | -Descriptive statistic<br>-non-parametric Kruskal-wallis test |
| Do socioeconomic factors influence the perceived value of the GSCP? | $I_F$<br>$I_{GSCP}$<br>$I_{Ag}$<br>$I_{offsite}$<br>H-demographics<br>H-assets | Pearson correlation |
| How do benefits arising from the management of the GSCP differ among communities? | Extension services<br>Training<br>Other benefits | -Descriptive statistic |

**MB: Medina Bank, GS: Golden Stream, IC: Indian Creek, H: household

### 3.5.2 Comments and feedback

The opinions, perspectives, and experiences of households with the management of the GSCP by Ya'axché were noted in the comment section of the direct use value questionnaire. These comments were subsequently transcribed into an electronic format. A brief text analysis was conducted with the InfraNodus open source software to understand the comments of households. Using the open source java script, comments were reduced to lemmas. Lemmas refers to the roots of words or subject of argument emerging from the comments. By reducing comments to lemmas, redundant words are reduced to a 'common denominator'. Lemmas are then visualized in a text network graph. The mapping of text is based on co-occurrences and relationships of lemmas. Lemmas are presented as nodes in the graph. Influential keywords are subsequently identified by a ranking algorithm which uses frequency and centrality (shortest connections between words). Influential keywords were used to construct discourses (topics) of households.

## 3.6 Ethical considerations

This research was conducted in indigenous Maya communities. Prior informed consent of community leaders was obtained prior to executing household interviews. All the participating households within this researched participated on a voluntary basis. Even in the case of Indian Creek where community leaders provided a list of participants, households were given the option to refuse participation. All participating households were informed about the purpose of

the research prior to data collection. Participants were treated with anonymity throughout data collection and data analysis. The names of participants were only recorded if they agreed to.

Repetitiveness of population was attempted at the highest possible degree. Each community had equal representation in this study (10% of households). With the exception of Indian Creek, random sampling was undertaken (see chapter 7 for limitations). At Indian Creek, where households listed by community leaders refused to participate, a replacement household was randomly selected. Although most of the recorded participants were males, the participation of female household leaders was encouraged. This was achieved by agreeing on a date and time for interview where both household leaders were present. In some cases, even children had some input in the household interviews.

During the prior informed consent meeting with leaders, it was agreed that the results of this research will provided to them. This will be achieved by providing a copy of this thesis to Ya'axché.

# CHAPTER FOUR

## 4. Embedded case studies

This chapter presents direct use values of the GSCP at the case study sites as income. This presentation is made to facilitate the comparison between values [income] derived from the GSCP with other household incomes. Distinction between cash and subsistence incomes is also made following Ellis (1998). Cash income refers to cash earnings obtained from the sale of agricultural produce (including crops and livestock) and forest products, as well as those earned from offsite activities. Offsite income here refers to wages obtained from employment, and earnings from other off farm activities such as the entrepreneurship ventures and the sale of handicrafts. Subsistence income refers to in-kind consumption of own agricultural produce (including crops and livestock), and forest material. Using these modes of income reporting, the three case studies are presented here.

### 4.1 Case study 1: Medina Bank Village

Medina Bank is approximately 9 kilometers north-north east of the GSCP (Figure 9). It is located about 109 kilometers along the Thomas Vincent Ramos Highway in the Toledo District. Medina Bank was recognized as a village in the early 1990's. Medina Bank is approximately 10 $km^2$ of enclavement within the Deep River Forest. The Deep River Forest Reserve is approximately 4,600 hectares of pine savanna and lowland broadleaf forest protected since1941. The forest reserve is managed under a logging concession by the Thomas Gomez and Sons' Saw Mill. From the three embedded cases, Medina Bank is the least developed community in terms of infrastructure.

Most of the Medina Bank's territory is dedicated to traditional shifting cultivation, or as the locals call it, *milpa* farming. The Deep River runs north of the village and separates the settlement from the *milpas* along its eastern bank. The village has a solar powered potable water system which pumps water from a spring bordering the Deep River. Homes which are not connected to the water system rely on hand pumps and wells for potable water. The Deep River is also an important meeting point for women to do laundry. Medina Bank is not connected to the national electric grid. Several community members have small solar panels which provides lighting. Roads within the community have been opened by the government. They have however become overgrown due to the lack of maintenance. The village has one primary school which is managed by the government of Belize. Three evangelical churches can be found within

the community. The village also has a community center where communal events such as elections and meeting are held.

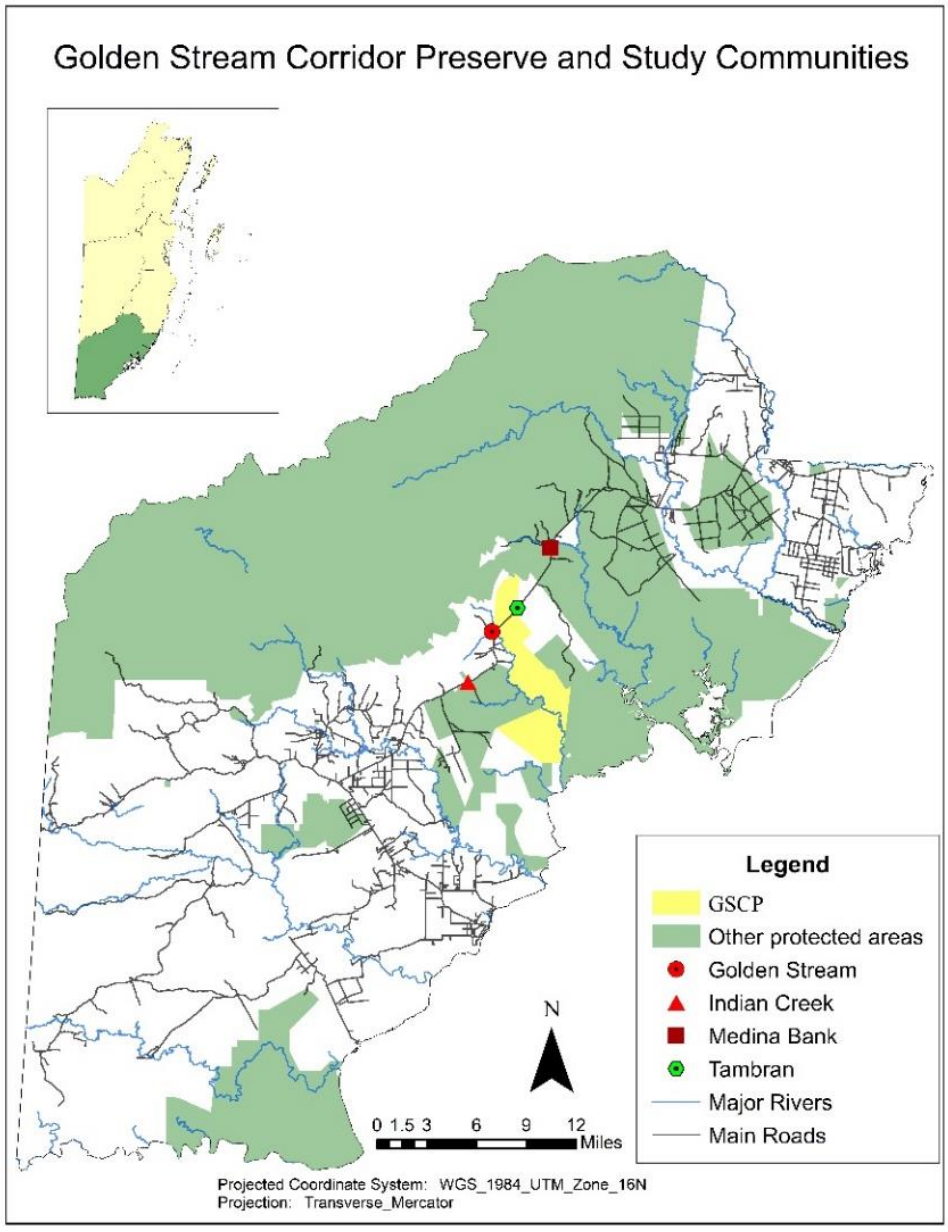



Figure 9: Location of embedded cases: Medina Bank, Golden Stream, and Indian Creek Village and other buffering communities. (Source: created by author).

### 4.1.1 Demography of participating households

Medina Bank is predominantly a Kekchi Maya community. Community leaders report that there are between 60 to 70 households within the community. The population size fluctuates as the community experiences high rates of immigration and emigration due to differential customary rules. Customary laws at Medina Bank allow the integration of outsiders (predominantly Kekchi Mayans) within the community at a rental fee which is agreed between community leaders and the entrant family. When a family leaves the community, all

infrastructure built on community land belongs to the community and becomes a vacant home for future 'tenants'.

In this study nine (9) household leaders at Medina Bank were interviewed. All participating household were Kekchi Maya. The average age of the household leader was 52. Six (6) household leaders were males and three (3) were females; although in most cases both household leaders were present during the interview. All the female participants (3) were housewives and did not part take in any form of cash income generation. All male participants (6) were farmers, of which 4 dedicated their time exclusively to farming; one had a small grocery shop and another divided his time between farming and working as a laborer at the banana farms and banana packaging facility in Bladen (a small community about 15 km east of Medina Bank). Five participants (56% of participants) did not have any form of education; three completed primary schools, and one had secondary school education. The household size ranged from a minimum of 4 to a maximum of 17 members. The average household had 8 members. The majority of the participating households (5) have been residing in Medina Bank for at least 40 years. Four households moved to Medina Bank recently; between 1 to 3 years ago.

Medina Bank holds traditional land right over its territory. Seven of the nine participating households have farming land. The two households which did not possess any form of land immigrated to the community one year ago. Six households held their farmlands under communal titles, and only one household had a formal lease title. The definition of communal lands seems to be unclear amongst community members. Since 2009, the Supreme Court of Belize asserted the traditional land rights of the Mayas in Southern Belize. However, several community members hold lease titles to their lands prior to the 2009 ruling. Granted, lands which have leased tittles are still recognized as communal lands, but the limits and size are respected under customary laws. The size of the farming lands ranged from 4 to 25.6 hectares, with the average farm being 11.6 hectares.

The area cultivated on a farmer's *milpa* ranged between 1 to 4 hectares, regardless of the size of land owned. This is primarily because farmers practice shifting cultivation on their lands. Cultivation occurs between 5 to 10 years on one location. The farming area is subsequently abandoned and a new forested area is cleared for farming. On average, farmers at Medina Bank cultivated 28% of their lands, about 16% was under secondary forest growth (follow) and more than 50% was under high forest (Figure 10). The larger the farm land, the higher the area under follow and high forest. Forests on farmlands are the main source of forest products such as construction material, fuelwood and edible plant product.

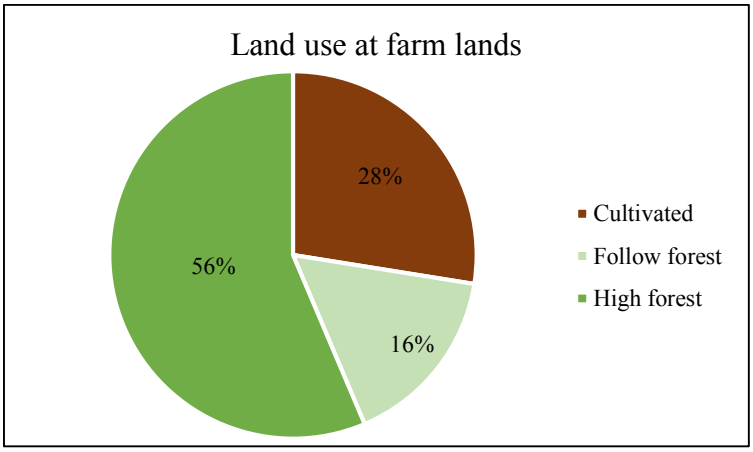



Figure 10: Percentage of farm land under cultivation, follow forest and, and high forest at Medina Bank.

### 4.1.2 Forest utilization: Subsistence and cash income

Households at Medina Bank are dependent on the forest for construction material, edible plant products, bush meat, medicinal plants, and other forms of Non-timber forest products (NTFPs). Despite being an enclavement within the Deep River Forest Reserve and a buffering community to the GSCP; all forest products are obtained from communal lands. Communal land here refers to house lots within the community, farm lands, as well as other communal lands which are held under communal ownership by Medina Bank. With the exception of timber, forest products can be accessed free of cost by community members. Logging is only allowed for subsistence purposes. Timber trees can be harvested after a permit fee of 10 BZD (5 USD) is paid to the community.

Access to community forest resources in Medina Bank is a given. If a community member does not have any communal land, forest products are usually harvested from the property of a neighbor or a family member. In the event where a villager does not have any family within the community, access to resources is allowed on communal areas which do not have ownership. Outsiders, usually family members who live outside of Medina Bank, are allowed access to construction material—except timber—provided that they pay an entrance fee of 15 BZD (7.50 USD).

**Construction material**

All participating homes obtained construction material from the forest. Households utilize 4 major forms of construction material from the forest: palm fronds from the palm A*ttalea cohune* as thatch; poles for the construction of an A-frame for roofing; posts and beams for structural support; and lumber slabs for walls (Figure 11). Cohune fronds are usually harvested in backyards where several cohune palms are kept. A cohune palm can yield up to 16 cohune

fronds. Three to four young fronds are usually kept to allow the palm to recuperate. Other construction materials are collected from farmlands or communal lands.

Figure 11: Typical construction of a home at Medina Bank (Source: author)

The frequency of the demand for these materials varies. Both the palm fronds and sticks and poles on a home's roof is replaced every 6 years (on average), although some community members indicate that these can last up to 8 years. The lumber walls of homes on the other hand can last up to 15 years, and are replaced one by one when the need arises. Hardwood species with heart wood such as Sapodilla (*Manilkara zapota*) and rosewood (*Dalbergia stevensonii*) are typically used for posts. On average, a post can last three construction periods of 6 years. The quantities of construction material used by each household varies; usually depending on the dimension of the home.

At Medina Bank, a family typically owns one home. Only two of the participating households owned 2 separate homes; one serving as a dormitory and the other as a kitchen and storage room. Homes typically have a dimension of 15x20 feet (or 4.6m x 6.1m). On average, a home uses 794 cohune fronds as thatch. The A-frame of a home's roofing uses an average of 80 poles of different dimensions as rafters and beams. Homes at Medina Bank use and average of 14 post for the construction of home's main frame. The dimension of the posts varies, these usually have a length of 3 meters and a diameter between 15 to 30 cm; although corner posts are thicker in diameter. On average a home uses 60 slabs of lumber which may have varying dimensions: usually of 2.5cm x 36cm x 180cm (1"x14"x6' in local dimensions). Timber species used for wall varies. They are usually low quality soft woods.

Households at Medina Bank use an average of 1,203.67 BZD (601.84 USD) worth of forest construction material; of which 873.89 BZD (436.95 USD) is derived directly from community

forests. Notwithstanding, most households received a subsistence income above the community average (Figure 13). Subsistence income has been calculated from the local price of forest construction materials indicated by community members (see Table 4 for a summary). The sale of construction material is not a common practice at Medina Bank, primarily because construction material is readily available in farm lands, communal forests and backyards. Interviewees agreed that on average, a palm frond can fetch a price of 0.50 BZD. Although no one in the village purchases material for rafters and beams, material for an A-frame roof can be bought locally. Poles and beams for the A-frame of a home is typically sold/bought as one-unit cost of about 350 BZD. In all cases, posts were extracted from the community forests. Traditional laws require a fee of $10 BZD per post regardless of length, diameter. Lumber is the only construction material that is not extracted from the community forest. Lumber is bought from the nearby sawmill at a value of 0.80 BZD per board feet which translates to roughly 5.60 BZD per piece of lumber.

Table 4: Summary of average construction material used by households, reported price by community members, and average household subsistence income.

| Type of construction material | Average quantity used | Price per unit | Average household subsistence use |
|---|---|---|---|
| Cohune fronds | 794 | 0.50 | 397.22 |
| Poles for A frame | 80 | 350.00 | 466.67 |
| Posts | 14 | 10.00 | 108.89 |
| Lumber | 60 | 5.60 | 329.78 |
| Total Average | | | 1,203.67 BZD |

**Edible forest products and bush meat**

Edible forest products are collected year round at Medina Bank. Eight of the participating households indicated that they collected edible plant and hunted for bush meat in communal forests. All edible plants collected are used exclusively for home consumption. The most commonly collected edible plant product are young shoots from the palm *Carludovica palmate* or commonly known as jipijapa. Households at Medina Bank collects about 17.8 kilograms of jipijapa shoots in a year. Jipijapa palms usually grow in disturbed forests and are a common occurrence after farmlands are abandoned. Follow forests at farms lands are the main source of jipijapa.

Cohune cabbages are the second most common edible plant forest product collected. Cohune cabbages is the common name given to the apical meristem—or young shoot—of the palm A*ttalea cohune* (same palm used for thatch). Cohune cabbage is rarely harvested as the palm is killed in the process. Cohune cabbage are usually collected when agricultural clearings are made, or in cases where there is an abundance of cohune. Villagers report that a cohune palm

can yield up to 2.5 kilograms of cabbage. On a yearly basis, households at Medina Bank harvest an average of 8.15 kilograms of cohune cabbage.

The third edible plant collected from communal forests is pacaya. Pacaya is the common name given to the palm *Chamaedorea tepejilote*. The young inflorescence of this palm is collected as a food source between November and January every year. Pacaya palms are usually found as an understory palm in high forests. Pacaya are typically collected from the high forests of farms or along the riparian forest of the Deep River. On average, a household consumes about 15 bundles of pacaya; each consisting of about 10 inflorescence buds.

Although not an edible plant material, waha leaves are included in this section. Waha is the common name given to the understory plant *Calathea lutea*. Waha leaves are most popularly used as wrap for the preparation of traditional dishes such as *tamales* (a Mayan corn bases meal) and *lancha* (grilled vegetables or meat). Waha leaves grow in humid areas and are usually collected in follow forests or along the flood plains of the Deep River. The use of waha leaves peaks during celebrations such as weddings, when food is prepared in large quantities. On average, a household uses 289 waha leaves in a year.

Hunting is a traditional practice at Medina Bank. Only 3 of the 9 participating households (33%) indicated that they hunt within the limits of the communal forest. Households go on hunting expeditions at least once a month. Interviewees however clarified that not all hunting expeditions are successful. Bush meat is exclusively used for home consumption. Hunting is often a group effort. The kill is therefore dived evenly amongst the hunting team. Although Belize has several game species, households only reported the active hunting of 3 major mammalian species; an average of 1 gibnut (*Cuniculus paca*), 1 peccary (*Tayassu tajacu*), and 1 white tailed deer (*Odocoileus virginianus*).

Table 5: Summary of average quantity of edible forest product utilized by household, market price for each unit and average subsistence income of households.

| **Forest product** | **Quantity** | **Price per unit (BZD)** | **Average household subsistence income** |
|---|---|---|---|
| JipiJapa shoot (kg) | 17.8 | 6.00 | 108.33 |
| Cohune cabbage (kg) | 8.15 | 8.00 | 70.67 |
| Pacaya (bundles) | 15 | 2.00 | 15.11 |
| Waha leaves (units) | 289 | 0.10 | 28.89 |
| Gibnut (kg) | 15 | 12.00 | 240.00 |
| Peccary (kg) | 30 | 10.00 | 33.34 |
| Deer (kg) | 40 | 14.00 | 62.22 |
| Total | | | 1,624.98 (BZD) |

On a yearly basis, a household in Medina Bank receives an average of 1,624.98 BZD (812.49 USD) of subsistence income from the collection of edible forest plant products, and bush meat. These values were calculated from the estimated market value of each edible forest product indicated by community members (see table 5 for a summary). Subsistence income from edible forest products varied greatly (standard deviation of 702.06 BZD); although most households (55%) received a subsistence income above the community average (Figure 13)

**Fuel wood**

Fuelwood is an important forest product for households at Medina Bank. Fuel wood is used for cooking meals three times a day. Fuel wood is gathered within communal lands; at backyards, at agricultural clearings, and from communal forests. Other large scale clearance within the community, such as the clearing of land for electrical posts, are also sources of fuel wood. Trees are never felled for fuelwood. Although fuel wood is not scarce at Medina Bank, households indicated that some community members purchase fuelwood at Pine Hill; a neighboring Mennonite community. Households indicated that many species of trees are used for fuelwood, although hard woods are preferred due to their high caloric value.

Table 6: Summary of fuelwood collection at Medina Bank and average household subsistence income from fuelwood.

| Frequency of collection | Form of collection | Average volume per year | Average household subsistence income |
|---|---|---|---|
| Weekly | Bundles | 11.1 | 330.01 |
| Periodically | Pickup load | 10.5 | 350.32 |
| Average | | | 336.78 (BZD) |

All households at Medina Bank use fuelwood. The gathering occurs in two forms: in bundles or by pickup loads. Three households indicated that they gather fuelwood in bundles, and 6 indicated that they prefer gathering fuelwood in pickup loads. Households who gather fuelwood by bundles do so throughout the year. On average, three bundles are gathered on a weekly basis. Each bundle has about thirty pieces of wood of varying lengths and dimensions. Based on household reports, a bundle consists of about 0.08 $m^2$ of fuelwood. Collecting fuel by pickup loads usually occurs during the dry season (March to May). Collection effort occurs at least twice during the dry season. A pickup load of fuel usually consists of about 1.9 $m^2$ of fuel wood. Households at Medina Bank use a minimum of 7.6 $m^2$, a maximum of 15.2 $m^2$, and an average of 10.7 $m^2$ of fuel wood on a yearly basis. Fuelwood is often sold at a price of 60 BZD per pickup load. This is equivalent to a price of about 31.58 BZD per cubic meter of fuel wood. This value has been calculated from the average cubic meters in a pickup load. Granted, a household in Medina Bank therefore receives an average of 336.78 BZD (168.39 USD) of

subsistence income from the collection of fuel wood (Table 6). Subsistence income from fuelwood varied between households (standard deviation of 111.91 BZD). Most of the households observed a subsistence income above the community average (77%) (Figure 13).

**Summary of subsistence income from forest utilization at Medina Bank**

Forest utilization at Medina Bank has been categorized into three major groups: construction material, edible forest products, and fuel wood. No cash income is generated from the collection of these forest materials. Households at Medina Bank receives an average of 2,265.39 BZD (1,132.70 USD) of subsistence income from the utilization of forest products. More than half (57%) of this subsistence income reported by households was obtained from the collection of construction material (Figure 12). It must be however pointed out that this activity occurs every 6 to 8 years. Other forest products are collected more frequently, and therefore have annual importance. The collection of edible plant material and the hunting of bush meat represents 24% of the household's annual subsistence income. Eighteen percent of subsistence income came from to from fuelwood, and only 1% from the utilization of other NTFPs. The subsistence forest income from these 4 major groups varied amongst households (Figure 13). A non-parametric Kruskal-wallis test revealed that only subsistence income from NTFPs was significantly lower than the other subsistence income; significance between 0.000 and 0.035 (See annex 3 for pairwise comparisons). This is primarily because other NTFPs are not widely used by households, and also because of the low price waha leaves fetch on the local market. This subsistence income also does not account for medicinal plants, which is a major part of a household's lifestyle.

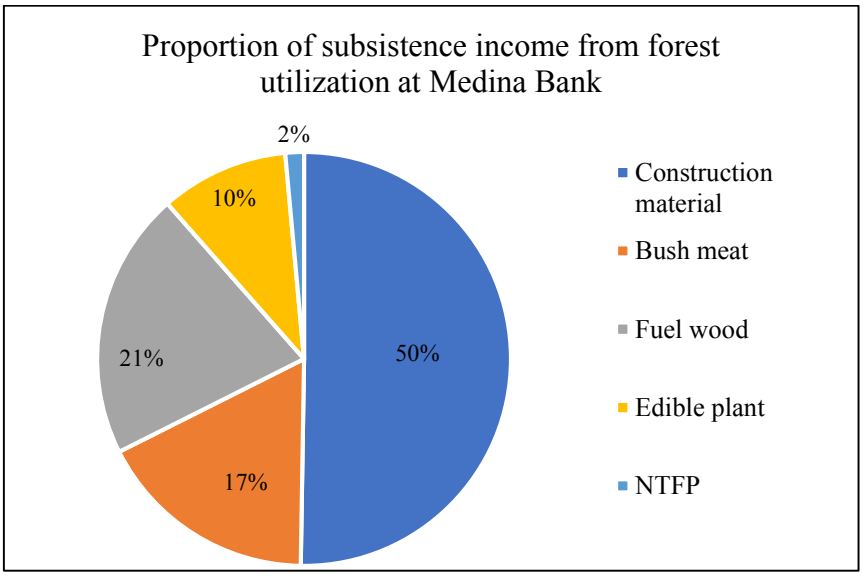



Figure 12: Percentages of subsistence income from construction material, edible forest product, and fuel wood received by households at Medina Bank.

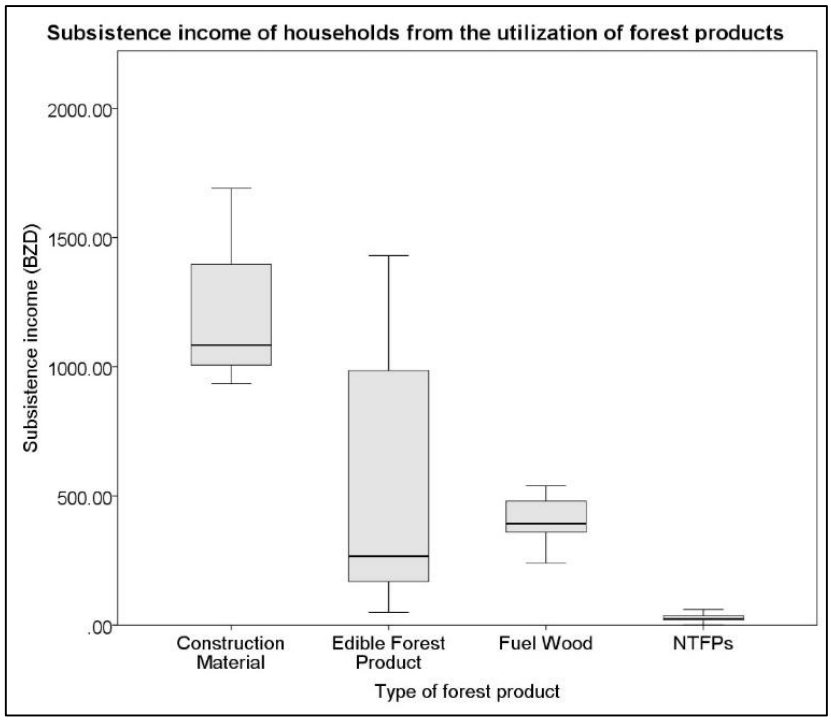


Figure 13: Breakdown of subsistence income of households from forest utilization at Medina Bank.

### 4.1.3 Agriculture: subsistence and cash income

**Milpa**

Shifting cultivation, or *milpa* farming is the main source of subsistence food. White and yellow corn varieties (*Zea mays*) are cultivated by farmers. Corn is cultivated twice a year. The largest harvest, is cultivated between June to November during the rainy season. The *matabre* corn (summer/dry season harvest) is cultivated between December to March. White corn serves as the main source of food on a daily basis. Red kidney bean and black bean (*Phaseolus Vulgaris*) varieties are also cultivated. Beans are cultivated at the end of the intense rainy season in December. Two major tubers or ground food are cultivated on farmlands; cassava (*Manihot esculenta*) and cocoyam (*Colocasia esculenta*). These tubers are planted and harvested year round. Plantains (genus Musa) are cultivated both on farm lands as well as in backyard gardens. Several varieties of hot peppers (usually habanero), okra (*Abelmoschus esculentus*) and pumpkins are also cultivated. These crops are often grown in backyard gardens. Table 7 summarizes the average amount of crop consumed for subsistence, and the subsistence income obtained from each crop.

A household at Medina Bank earns an average of 248.89 BZD (124.45 USD) of cash income from the sale of white corn and cassava. More than 75% of this cash income comes from the sale of cassava. This cash income does not account for family labor and investment in material.

Table 7: Summary of subsistence income of households at Medina Bank from *milpa*.

| Crop | Price per unit (BZD) | Average Quantity consumed (kg) | Average household subsistence income |
|---|---|---|---|
| White corn | 0.90 | 703.5 | 497.00 |
| Yellow corn | 0.90 | 85.5 | 67.00 |
| Red kidney beans | 3.00 | 35.5 | 83.00 |
| Black beans | 2.00 | 35.5 | 56.00 |
| Pumpkin | 2.00 | 4.5 | 7.00 |
| Hot pepper | 3.00 | 5 | 12.00 |
| Plantain | 7.50 | (Bunches) 11 | 67.00 |
| Cassava | 4.00 | 80.5 | 61.00 |
| Cocoyam | 3.00 | 14.5 | 33.00 |
| Okro | 2.00 | 6 | 9.00 |
| **Total** | | | 887.50 (BZD) |

**Livestock: subsistence and cash income**

Household in Medina Bank owned only 2 major forms of livestock: local chickens and pigs. On average a household owns about 23 local chickens and about 1 pig. Local chickens are fed with corn and also allowed to forage freely in backyards. Chickens are slaughtered or sold when they achieve an average age of 2.5 kilograms. All households indicated that local chickens are sold at an average of 10 BZD (or 5 USD) per kilogram of live weight. Pigs on the other hand are kept in enclosed pens or tied in the backyard. Pigs are normally fed with corn. Occasionally pigs are released to forage on post-harvest crop residue in backyard gardens. Several households described the rearing and slaughtering of pigs as a family affair. Often, pigs are reared in a collective manner where leftover harvest and food are fed to pigs. The subsequent slaughtering involves the entire household as well as relatives. A pig is slaughtered when it has reached a weight of about 150 pounds (or about 75 kg). The butchered pork is shared among relatives, and often with neighbors who assist with the slaughtering. The butchering of a pig is usually reserved for special occasions such as weddings or for village festivities. The sale of pigs in Medina Bank is rare. When sold alive, a pig fetches an average of 5 BZD (or 2.5 USD) per kilo. Butchered pork fetches an average of 10 BZD (or 5 USD) per Kilogram. None of the participating households indicated to have a cash income from the rearing of local chickens and pigs.

A household at Medina Bank receives an average of 688.89 BZD (or 344.45 USD) of subsistence income from the rearing of livestock (Table 8). This average is derived from the live weight price of both chickens and pigs. This value also does not discount input from feed, labor or time. The variation of subsistence income from livestock across households was

significant (standard deviation of 443.66 BZD). This is because households who reared pigs generally observed higher total subsistence income.

Table 8: Distribution of subsistence income from livestock at Medina Bank in BZD.

| **Livestock** | **Quantity** | **Weight (kg)** | **price /unit (BZD)** | **Average subsistence income** |
|---|---|---|---|---|
| Local Chicken | 23 | 2.5 | 5.00 | 500.00 |
| Pigs | 1 | 75 | 2.50 | 166.67 |
| **Total** | | | | 688.89 (BZD) |

On a yearly basis, a household at Medina Bank receives an average of 887.50 BZD (443.75 USD) of subsistence income from the cultivation of crops. This value has been calculated from the local price of crop produce (Table 5.4). Seventy-eight percent (78%) of this subsistence income is constituted by staple foods; beans (9% red kidney beans; 6% black beans) and corn (55% white; 8% yellow) (Figure 14). More than 50% of subsistence income from crops comes from the cultivation of white corn. This is primarily because *milpa* farming has been traditionally used to produce subsistence food. The values presented here do not account for investment in family labor and material such as seed and tools. From the cultivated crops, cash income is only generated from the sale of white corn and cassava.

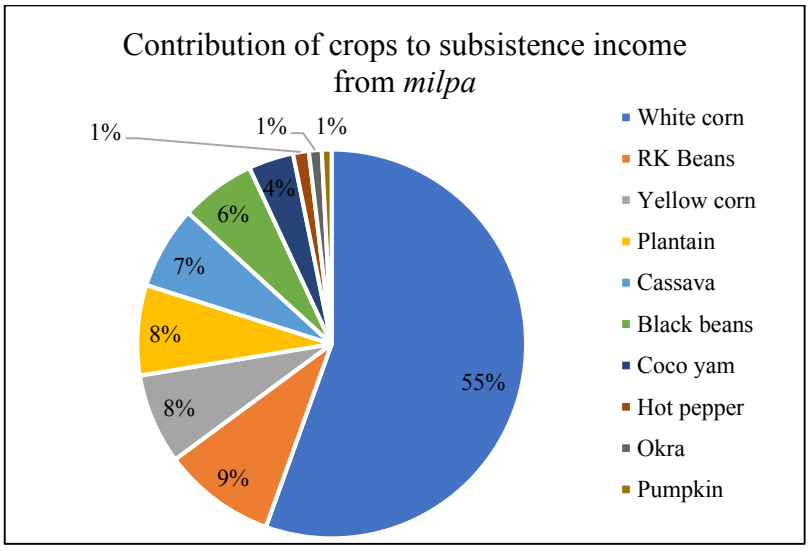



Figure 14: Contribution of crops to subsistence income from the cultivation of crops at Medina Bank.

Only one household at Medina Bank indicated to have cash income generation from the rearing of the broiler chicken breed. Broilers are reared in batches of about a 100 and are fed both corn and commercial feed for approximately 6 to 8 weeks. Broilers are sold when they are about 2.5 kilograms at a price of 4 BZD (or 2 USD) per kilogram of live weight. Broilers are rarely slaughtered prior to sale. This may be due to the absence of refrigeration as a consequence of the lack of electricity. The family rears about 220 broilers throughout the year and receives a

cash income of 2,200.00 BZD (or 1,100 USD). This sum does not discount labor or and investment in feed.

**Agroforestry**

Two household indicated that they have agroforestry plots. The agroforestry plots averaged at 0.8 hectares. At the agroforestry plots, farmers have cocoa, coffee, mahogany trees, and an array of fruit trees. The plots were established 3 years ago, thus the plots are not productive. The plots were established with training and aid from Ya'axché. Technical training on planting strategies, pest control, pruning and soil management were provided free of cost. Seedlings for the agroforestry plots were also provided. Extension services and follow-up support was and is currently provided by the extension officer and community liaison of Ya'axché.

### 4.1.4 Cash income

**Offsite income**

Seven of the nine participating households reported that they have an offsite job, and two reported to be unemployed. All of these households with employment (100%) depended on banana farms at Bladen for labor (Figure 15). At the banana farms an individual earns an average of 29 BZD (14.50 USD) for a day's labor, and an annual salary of 5,977.40 BZD (2,988.70 USD). Only one household reported to be employed in the tourism sector, and another owned a small grocery shop. The cumulative average of the annual offsite cash income of households at Medina Bank is 7,422.44 BZD (3,711.00 USD). None of the participating households reported to have income dependent on Ya'axché, or related to the management of the GSCP.

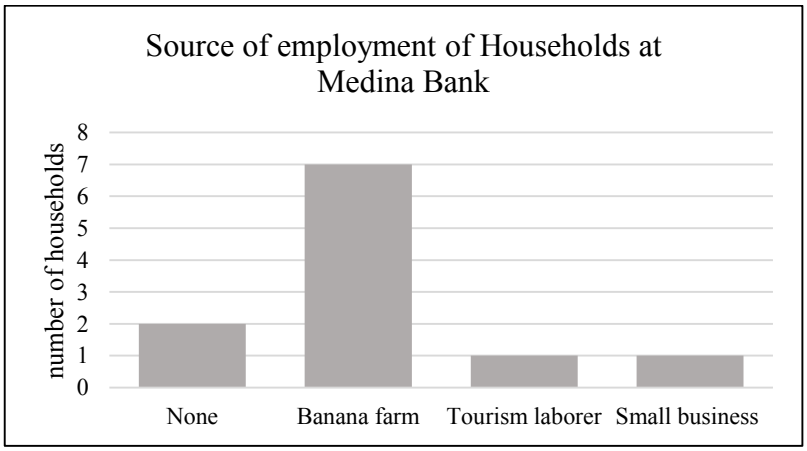



Figure 15: Modes of offsite income and number of households involved in activity.

**Summary of cash income**

A household in Medina Bank receives cash income from offsite employment, the sale of crops and from the rearing of livestock. The Average annual cash income of a household at Medina Bank is 7,915.78 BZD (3,957.89 USD). Ninety-four (94%) of a household's cash income is

dependent on offsite employment; of which 0% directly dependent on the management of the GSCP. Cash income varied amongst households (Figure 16). This was directly related to the number of working adults in a household. Cash Income from the sale of livestock and crops was significantly lower than offsite income. This accounted for only 6 percent of the household's cash income (3 percent respectively). Income of households from labor at Medina Bank is less than the average income per capita in Belize. The labor force survey in 2019 reported an income per capita of 14,928.00 BZD or 7,464 USD in Belize (Statistical Institute of Belize, 2019). Subsistence income from the collection of forest products; *milpa* farming, and the rearing of livestock plays an undoubting role in bridging this income gap.

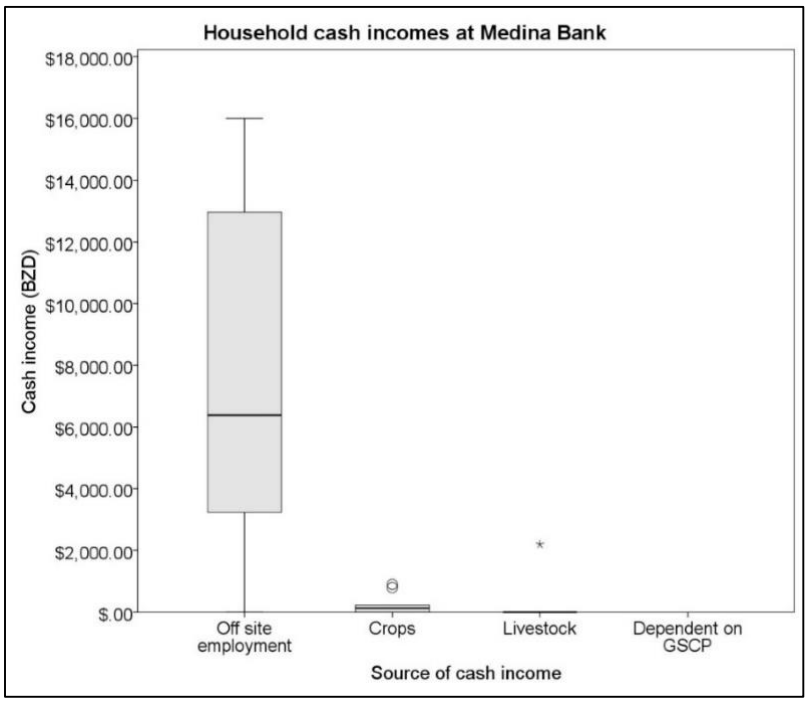



Figure 16: Makeup of household' cash income at Medina Bank.

### 4.1.5 Benefits arising from the management of the GSCP

Four of the participating households (44%) indicated that they perceived direct benefits from the management of the GSCP during the past 5 years. All benefits observed benefits stemmed from the implementation of the community outreach and livelihood programs by Ya'axché. Each household received at least two forms of benefits; with fire and agroforestry trainings being the most common (Figure 17). Other benefits included the donation of seedlings for the startup of agroforestry plots, training in coffee agroforestry, inga alley cropping, high school scholarships and field exchanges. Although knowledge is gained during these efforts, the economic value of these benefits were not recorded during this research.

Agricultural fire training has been one of the recent efforts by Ya'axché to address problems associated with escaped agricultural burns. Community fire trainings transfers skills on

strategies for conducting prescribed burns in agricultural lands. Despite these trainings, farmers reported that the incidence of escaped fire is still high. One farmer reported losing his *milpa* crops and inga plot to an escaped fire.

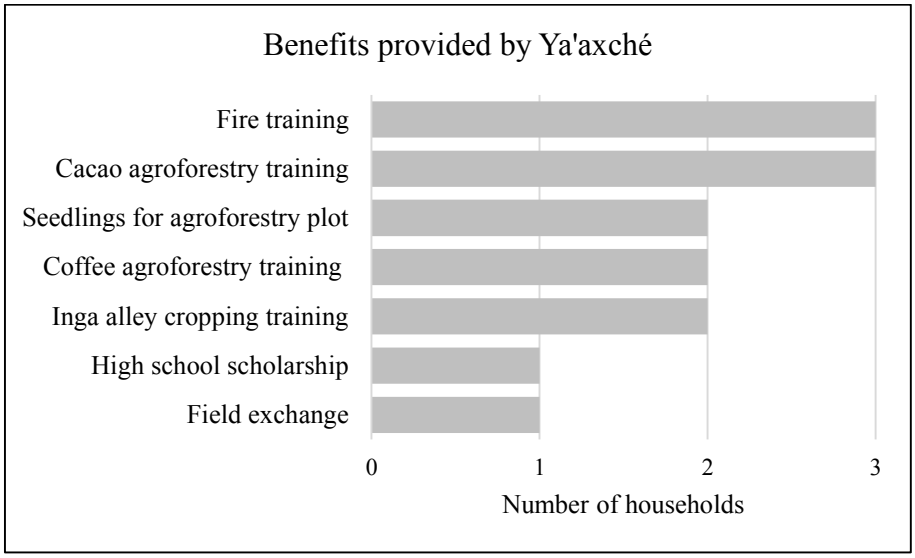



Figure 17: Benefits receives by households from the management of the GSCP.

Cacao and coffee agroforestry, and inga alley cropping trainings and extension services are provided by Ya'axché as part of their climate smart farming strategies. These initiatives are also part of Ya'axché's livelihood initiative which seek to create sustainable livelihoods. Training sessions share knowledge on the establishment and management of cacao and coffee plots, as well as the management of an inga alley plot. During these trainings farmers are usually provided seedling for plot startups, or are offered seedlings at a discounted price. From the three households who were part of the cacao agroforestry trainings, only 2 had adopted the practice. One farmer reported that his cacao plot was lost to an escaped agricultural fire. Inga alley cropping has been recently adopted by 2 farmers. One farmer reported that his plot has been very beneficial to the prevalence of wildlife at his farm. He also reported that his corn yields have been improving in the past years.

High school scholarships offered by cover tuition fees or provide text books during 4 years of high school education. One household reported to have received a book scholarship from Ya'axché. Field exchanges are technology and skills transfer efforts where farmers visit demonstration farms in the MGL.

### 4.2 Case study 2: Golden Stream Village

Golden Stream village is a small settlement located along the north western border of the GSCP (Figure 9). It is located 113 kilometers along the Thomas Vincent Ramos Highway. Golden

Stream was founded in 1970 by migrant families in Southern Belize, as well as families from Guatemala. According to community leaders Golden Stream has a population of about 800 and 140 households. A majority of the population are Mopan Maya, although some Kekchi Maya live in the community. Most homes in the village have thatched roofs and wooden walls, but when compared to Medina Bank, there are more concrete homes at Golden Stream. The community also practices shifting cultivation for subsistence. These *milpas* are located in the outskirts of the village. Golden Stream is larger than Medina Bank, and is also more developed. The Golden Stream; after which the village is named, runs through the village. Although not the main source of potable water, the Golden Stream plays an important role in recreational and the day to day activities of households. Most households are connected to a rudimentary water system which draws water from an underground well. Water is pumped to a reservoir and is fed through gravity to households. Golden Stream has a cap for potable water use; which is the main reason why households still access the Golden Stream for laundry and other water needs. Golden Stream is not connected to the national electricity grid. Several households use small solar panels and diesel generators for electric power. A government run school can be found in Golden stream. The Village has a community center where village meetings and celebrations are held. There are two evangelical churches at Golden Stream.

The Belize Spice Farm & Botanical Gardens is located in the outskirts of the village. The company was established around 1990. The spice farm is a popular tourist destination which offers botanical tours, as well as Indian and Belizean cuisine. The Spice farm also owns a teak plantation and orange orchards. The company purchased the land where it is currently located from the community under the agreement that it will provide jobs to the local community. most of the household at Golden Stream work on a contractual basis at the spice farm.

### 4.2.1 Demography of participating households

Fifteen households at Golden Stream participated in this study. Sixty percent of participating household leaders (9) were male and the remainder were female. The average age of the household leader was 45. Households at Golden Stream had between 2 to 10 members, with an average of 6 members. On average, the households have been residing in Golden Stream for 31 years. Eleven household (73%) leaders had primary school education, 3 had secondary education and 1 had tertiary education. Thirteen households admitted to practice agriculture, however only 5 (38%) were entirely dependent on agriculture. Eight household shared their time between a formal job and farming, and 2 were unemployed. All participating females were housewives and did not partake in any form of cash income generation. Most of the participating households (87%) identified as Mopan Maya and the remainder as Kekchi Maya.

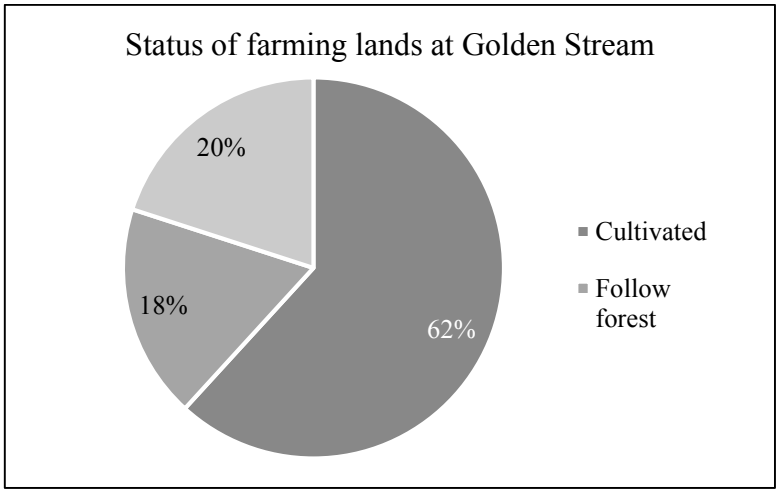



Figure 18: Status of farming lands at Golden Stream

Like Medina Bank, Golden Stream also has communal ownership over its lands since 2009. Unlike Medina Bank, outsiders rarely settle in the community. All families own house lots within the village settlement, as well as farming lands. Three households claimed to have leased tittles to their lands prior to 2009; the remainder held their farming lands under communal land tittles. Size of farming lands ranged from 0.8 to 10.1 hectares. The average farming land at Golden Stream was 4.1 hectares. Sixty-two percent of a household's farming land was dedicated to the production of crops, 18% was under follow forest and about 20% was highly forested (Figure 18). Seven households cultivated the entirety of their farm lands because it was small. Household indicated that population growth in the community has reduced the size of farming lands, and in many cases shifting cultivation is almost impossible. Household also believed that the establishment of the GSCP has also contributed to the problem because access to land in the protected area is not allowed. Nevertheless, communal lands further from the village are still forested, but are inaccessible during the rainy season.

**4.2.2 Forest utilization: subsistence and cash income**

Households at Golden stream depend on the forest for construction material, edible forest products and bush meat, fuelwood, other forms of NTFPs and medicinal plants. Despite being situated directly on the border of the GSCP, none of the households admitted extracting any of these material from the protected area. All forest products were collected from communal lands. These communal areas include backyards, farmlands and community forested areas which have no ownership. Forest resources at Golden Stream are considered to be public goods and are free for all community members to access. Timber trees are the exception to this rule. The extraction of timber for subsistence is allowed after a petty permit is obtained from the chairperson. The permit costs 10 BZD (5 USD) per tree—regardless of species. The permitting process operates independently from the Belize Forest Department.

**Construction material**

All participating households at Golden Stream collected forest products for the construction of their homes. Cohune fronds are used for thatching roofs; poles of different dimensions are used as rafter for the construction of an A frame; posts and beams directly harvested from the forest serve as the main frame of the home; slabs of lumber are used for the walls (Figure 19). Unlike homes at Medina Bank, households at Golden Stream still use vines to fasten cohune fronds to the rafters of their homes. Most of the construction material are collected from farmlands and communal forests. Only 4 households collected cohune fronds in their backyards. Keeping cohune palms in backyards has become increasingly difficult as more and more homes are built in the community.

Figure 19: Typical construction of homes at Golden Stream; one constructed in the traditional forest material (right), and another with modern construction material (left).

The demand for construction material from the forest varies. Households indicated that a home's thatched roof is weather proof for 6 years after which it has to be replaced—although it can last up to 10 years. In the process the A-frame conforming the home's roof, and vines are also replaced. Households indicated that after hurricane Iris in 2001, vines have been more difficult to find. They have therefore started to use nylon strings instead of vines. Vines are preferred, and when there is not enough it is substituted with nylon strings. Household reported that they used sapodilla (*Manilkara zapota*), rosewood (*Dalbergia stevensonii*), yemeri (*Astronium graveolens*) and madre cacao (*Gliricidia sepium*) as posts for their homes. All reported species are hardwood timbers. Within two constructions periods i.e. 12 years, at least 1 posts will be replaced. Lumber slabs on a home's wall are replaced when the need arises. Households indicted that if the walls are not directly exposed to the weather, they may last up

to 20 years. Species of timber used for walls are many; usually softwood species such as santa maria (*Calophyllum antillanum*), gumbo limbo (*Bursera simaruba*), hog plum (*Spondias mombin L.*), and spanish cedar (*Cedrela odorata*) are used. The quantities demanded also vary from household to household.

Thirteen of the fifteen participating households has two home. One home had either concrete or commercial wooden siding and tin (locally called zinc) or thatched roof. The second home was entirely constructed from forest material in the traditional manner (as seen in figure 19). Traditional homes often serve as kitchens, store rooms and as guest room. The 'modern' home serves as the dormitory. The average household at Golden Stream uses 913 palm fronds for thatching their roofs. Three households also used an average of 400 fronds from the bay leaf palm (*Sabal morrisiana*) as thatching for pig pens. Bay leaf palms are less common in the Golden Stream forests, but are preferred for the construction of pig pens because they last longer that cohune fronds. About 134 poles and beams of varying dimensions are for the construction of the A-frame for roofing. A home uses an average of 29 roles of vines for fastening cohune fronds on rafters. A role of vine consists of 6 vines which has a length of 15 feet (4.57 meters). Fourteen posts of varying dimensions are typically used for constructing the main frame of homes. A home's wall consists of about 62 wooden slabs (household mean) which are fastened vertically or horizontally to the main frame. The dimensions of these wooden slabs vary, although most households indicated that they are usually 1"x12"x7' (2.5cmx30.5cmx2.1m). All households reported that lumber used for their homes are logged from the community forests.

A household at Golden Stream receives an average of 1,415.24 BZD (707.62 USD) of subsistence income from the collection of construction material. None of the households indicated to have a cash income from the sale of construction material. This figure expressed in this section is based entirely on the local prices of forest construction material indicated by participating household. A cohune frond fetches 0.25 BZD (0.13 USD) in Golden Stream. Bay leaf palm frond are more sought after, especially by resorts. A bay leaf frond fetches 1 BZD (0.50 USD) on the local market, and double at the islands. Like Medina Bank, poles and beams for the A-frame of a home is usually sold as one unit. An A-frame can fetch up to 250 BZD (125 USD). Vines have no market price. Households however indicated that they would be willing to pay up to 5 BZD (2.50 USD) per roll. Posts are harvested at a fee of 10 BZD following communal rules. Timber is also logged at the same communal fee. However, the valuing was estimated from the price of board feet estimated by household. One plank of lumber has an estimated worth of 8.40 BZD (1.20 BZD per board feet). Table 9 summarizes the average quantity used and the cost each forest material

Table 9: Summary of average quantity of construction material, local price and average subsistence income of households.

| Type of construction material | Average quantity | Average price (BZD) | Subsistence income |
|---|---|---|---|
| Cohune fronds | 913 | 0.25 | 228.33 |
| Bay leaf palm fronds | 400 | 1.00 | 80.00 |
| Poles for A frame | 134 | 250.00 | 300.00 |
| Rolls of vines | 29 | 5.00 | 146.67 |
| Posts | 14 | 10.00 | 140.00 |
| Lumber planks | 62 | 8.40 | 520.24 |
| **Total** | | | 1,415.24 (BZD) |

**Edible forest products and bush meat**

All household at Golden Stream collected edible plant material from community forest. Edible plant material collected are similar to those collected at Medina Bank: Jipijapa palm shoots, Cohune palm epical meristem—locally known as cohune cabbage—, and pacaya palm inflorescence. Households which had large farm lands collect most of these edible plants from follow forest and high forested area. Households with smaller farming lands collected edible plants from communal forests, riparian forest and also from the other farmlands. Households consumed an average of 31.7 kilograms of jipijapa shoots, 20.5 kilograms of cohune cabbage, and 20 bundles of pacaya. The local price of edible plant products was similar to those at Medina Bank, with the exception of pacaya which fetched a lower price (Table 9). A household at Golden Stream receives an average of 245.67 BZD (122.83 USD) of subsistence income from the consumption of edible plant products.

Eight out of the fifteen participating households (53%) hunted for bush meat. Households went on one hunting trip every month. Households at Golden stream practiced group hunting. The hunt's kill is shared among the group, and when the kill is big enough also with neighbors. Households rarely sold bush meat as a means of cash income. Like Medina Bank, the most common game species hunted were gibnut, peccary and white tail deer. Hunting for these species usually occurs in the night. Gibnut and peccary are targeted by scouting and identify their feeding sites or watering holes. An improvised hunting blind is set at these sites and hunters return in the night. Deer are hunted by scouting farmlands or open forested areas; usually during the full moon. Households at Golden Stream also hunted armadillos (*Dasypus septemcinctus*). Armadillos are usually smoked or dug out from their burrows. On a yearly basis, a household consumes an average of 2 gibnuts, 1 peccary, 1 white tailed deer, and 2 armadillos. The reported price for bush meat are similar to those at Medina Bank. Households received and average of 781.07 BZD (390.54 USD) of subsistence income from hunting and the consumption of bush meat (Table 10).

Table 10: Average quantity and price of edible forest products and bush meat collected by household at Golden Stream.

| Edible forest product | Average quantity used | Price per unit (BZD) | Subsistence income |
|---|---|---|---|
| JipiJapa shoot (kg) | 31.7 | 6.00 | 126.60 |
| Cohune cabbage (kg) | 20.5 | 8.00 | 109.60 |
| Pacaya (bundles) | 20 | 1.00 | 9.47 |
| Armadillo (kg) | 2 | 7.5 | 9.64 |
| Gibnut (kg) | 30 | 12.00 | 218.57 |
| Peccary (kg) | 30 | 10.00 | 192.86 |
| Deer (kg) | 40 | 14.00 | 360.00 |
| **Total** | | | 974.67 (BZD) |

Subsistence income from edible plant products and bush meat amount to an annually average of 974.67 BZD (487.34 USD). Subsistence income varied significantly (standard deviation of 1,034.81 BZD) amongst households. This is primarily attributed to the high price of bush meat. Households who participated in hunting observed higher incomes from forest edible forest products.

**Other NTFPs**

Households also collected nonedible, non-timber forest products (NTFPs) from the community forest. Leaves from the Waha plant (*Calathea lutea*) are collected mainly along the riparian forests of the Golden Stream. Eighty-seven percent of participating households collected (13 of 15) waha leaves. The collection of waha leaves usually happens during the rainy season when they are more abundant. Waha leaves are used for as wrapping for the preparation of traditional food such as *poch* (steamed corn dough wrapped in waha leaves), and *tamales* (similar to poch except that it is filled with meat) to name a few. A household uses an average of 364 waha leaves annually. One household collected bayal palm (*Desmoncus chinantlensis*) stems. Bayal is a climbing palm which grows in disturbed forest. The bark of this palm is used for weaving baskets which are sold in the nearby town of Punta Gorda. Bayal is collected in bundles of 5 palm stems having lengths of about 10 feet (3.05 meters). A collection effort usually harvests about 10 rolls. The household collects about 50 rolls annually. Bayal is not sold as a raw material. Table 11 summarizes the price for these NTFPs. Note that the price per roll of bayal is based on the estimated quantity of baskets woven from 1 roll of bayal. A household at Golden Stream receives an average of 51.53 BZD (25.77 USD) of subsistence income from the utilization of NTFPs.

Table 11: Summary of quantity and price of non-timber forest products used by households at Golden Stream.

| NTFP | Average quantity used | Price per unit (BZD) | Average subsistence income |
|---|---|---|---|
| Waha leaves | 364 | 0.10 | 31.53 |
| Bayal (rolls) | 50 | 30.00 | 20.00 |
| **Total** | | | 51.53 (BZD) |

**Fuelwood**

All participating household reported to collect fuelwood from community forests. Household rely on fuelwood for cooking. Three households had gas stoves, but admitted to using more fuelwood due to the high price of butane gas. Fuel wood is usually collected along farm roads, at farm clearing, and at community clearings. Most households (13 households: 87%) collected firewood at least once a week in bundles. A collection effort (by bundle) usually consists of 3 bundles. A bundle makes up about 0.08 $m^2$ of fuelwood (this volume is estimated from the dimensions provided by households). Bundles are transported to homes on bicycles. Several species are collected as fuel wood. Species which have low caloric value are generally avoided. Only two households gathered fuelwood by pickup loads twice a year.

A household uses an average of 10.03 $m^2$ of fuel wood per year. Fuel wood fetches a price of about 43 BZD (21.5 USD) per cubic meter at Golden Stream (Table 12). This averages to an annual subsistence income of 429.87 BZD (244.94 USD) per household from the utilization of fuelwood. None of the households generated cash income from the sale of firewood.

Table 12: Summary of fuelwood collection and average subsistence income of household.

| | Form of collection | Average volume per year | Average household subsistence income |
|---|---|---|---|
| Weekly | Bundles | 9.82 | 420.85 |
| Periodically | Pickup load | 11.4 | 488.49 |
| Average | | | 429.87 (BZD) |

**Summary of subsistence income from forest at Golden Stream**

A household at Golden Stream receives an average annual subsistence income of 2,157.83 BZD (1,078.92 USD) from the utilization of forest products. Subsistence income of households from community forests is derived from four major types of forest material use: fuelwood; construction material; edible plants and bush meat; and other NTFP. Half of a household's subsistence income (50%) is obtained from collection of construction material; and 35% from the consumption of edible forest products (26% from bush meat; 9% from edible plants. NTFPs and fuelwood makes up 17 and 2 percent respectively (Figure 20).

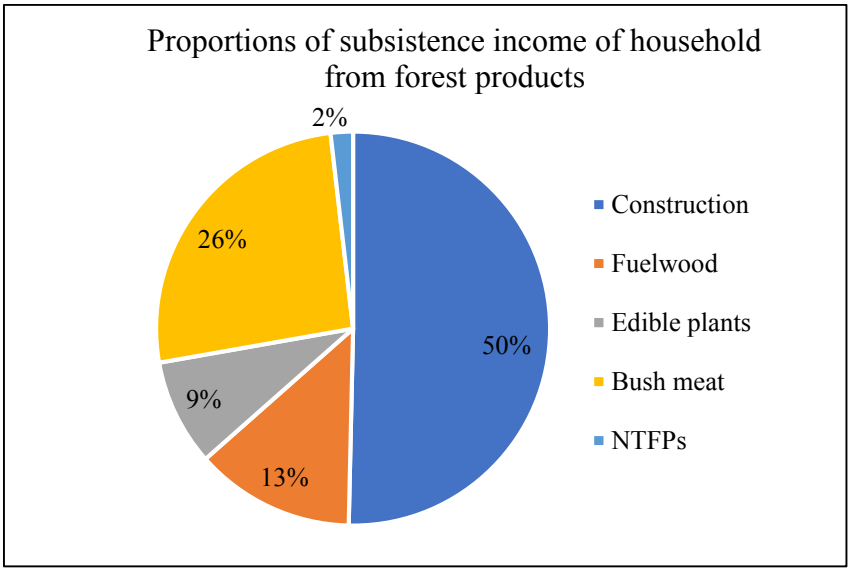



Figure 20: Proportional makeup of subsistence income of households at Golden Stream derived from forest use.

Subsistence incomes received from each type of forest material varied; however, only those derived from construction material and edible plants and bush meat varied significantly from those obtained from either fuelwood or other NTFPs (Figure 21). A non-parametric Kruskal-Wallis pairwise comparison revealed that subsistence income from NTFPs was significantly lower than other forms of forest products (significance between 0.000 and 0.021). Subsistence income from fuel wood was also significantly lower than subsistence from construction material (significance of 0.006). See Annex 4 for pairwise comparisons

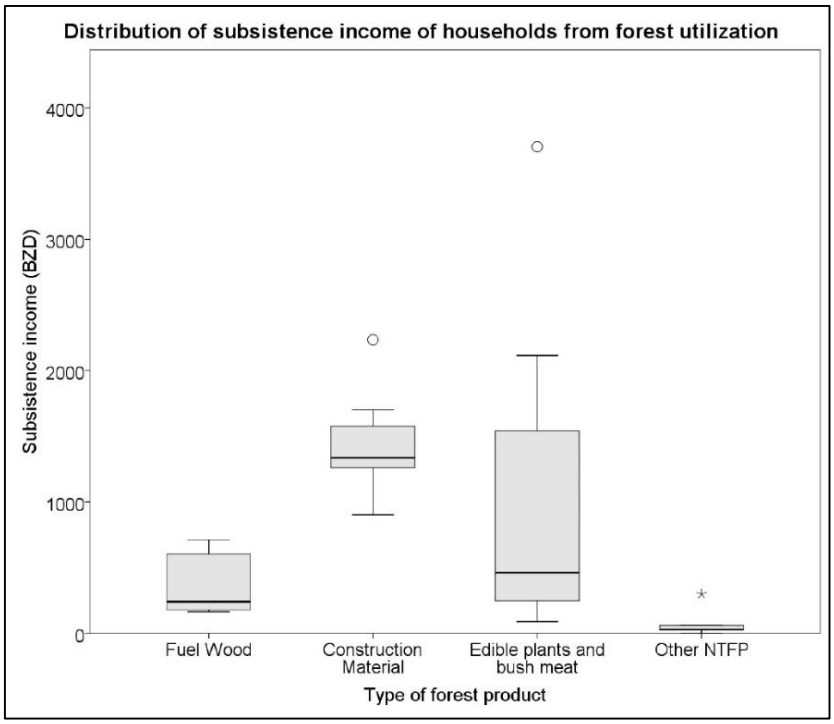



Figure 21: Subsistence income of households at Golden Stream derived from fuel wood, construction material, edible plant products and other NTFPs.

### 4.2.3 Agriculture: cash and subsistence income

**Milpa**

Shifting cultivation at Golden stream is referred to a *milpa* farming; although farmers also refer to their farmlands as "plantation". *Milpa* farming is the main source of food production for households. It is also a source of income. As is the case at Medina Bank, white corn, yellow corn, red kidney beans, black beans, pumpkin, hot peppers, plantain, cassava, cocoyam, and okro are the main crops cultivated by households. White and yellow corn are main source of food for household. Most of the corn cultivated (94%) is consumed by the household. Corn is cultivated twice a year. The first crops are sown around May during the first rainfall of the rainy season. The second crop, also called *matahambe,* is sown between November and December. Beans are cultivated less, primarily because they are more vulnerable to rainfall. Pumpkins, hot peppers and okro are cultivated both at farmlands and also in backyard gardens. Cassava, cocoyam and plantains are cultivated all year long. These three crops, along with ginger are cultivated household use and also as a source of cash income.

Households at Golden Stream receive an average of 1,163.77 BZD (581.89 USD) of subsistence income from the cultivation of crops. Table 13 summarizes the average quantity of each crop consumed by households and the price for each unit. White corn is the most cultivated and consumed crop (contributing 53% of subsistence income), followed by yellow corn, red kidney beans and black beans. Other crops contributed between 1 to 3 percent of a household's consumption (Figure 22).

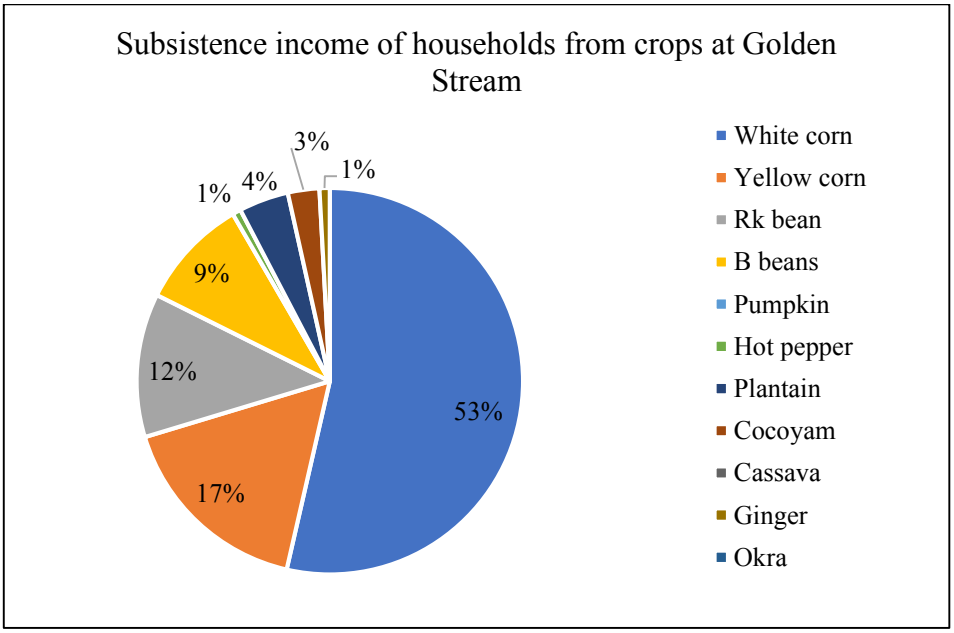



Figure 22: Percentage makeup of subsistence income received from cultivated crops by households at Golden Stream: RK bean: red kidney beans; B beans: black beans.

Table 13: Summary of the average quantity of crops used by households at Golden Stream, and the price per unit of each produce.

| Crop | Average quantity used (kg) | Price per unit | Average subsistence income |
|---|---|---|---|
| White corn | 725 | 0.90 | 624.00 |
| Yellow corn | 406.3 | 0.90 | 195.00 |
| Red kidney beans | 40.4 | 3.00 | 140.00 |
| Black beans | 49.1 | 2.00 | 108.00 |
| Pumpkin | 4.28 | 2.00 | 3.67 |
| Hot pepper | 3.1 | 3.00 | 8.27 |
| Plantain | (bunch) 12 | 7.50 | 48.50 |
| Cassava | 11.5 | 4.00 | 4.00 |
| Cocoyam | 16.45 | 3.00 | 30.67 |
| Okro | 7.5 | 2.00 | 1.00 |
| Ginger | 10 | 2.00 | 10.00 |
| **Total** | | | 1163.77 (BZD) |

Only a fraction of crops produced at *milpas* are sold for cash income; mainly surplus produce. A household earns only 356.17 BZD (178.09 USD) of annual cash income from the sale of crops. Most of this income is obtained from the sale of ground food at the local markets: 40% from cocoyam and 32% from cassava. Only one household reported an annual cash income from the sale of about 50 kilograms of wet cacao beans.

**Livestock**

Fourteen of the fifteen participating households (93%) owned livestock. Pigs, chickens, ducks, and turkeys were the most common form of livestock reared by households as a source of protein. Households owned an average of 25 local chickens. Two households also owned 6 turkeys and 4 ducks. All the afore mentioned livestock are free range raised. Seven of the participating households owned an average of 2 pigs. Households indicated that owning pigs can put an extra burden on the production of corn. Pigs were enclosed in pens and were occasionally released to forage freely in the community. All livestock are fed yellow corn, or lower grades of harvested white corn. Pigs are also fed post-harvest residue. Chickens are slaughtered when they achieve a weight of about 2.5 kilos; ducks when at 2 kilos, and turkeys about 6 kilos. Pigs are slaughtered when they have a weight between 75 to 150 kilos

A household receives 792.13 BZD (396.07 USD) of subsistence income from the rearing and utilization of livestock. More than half of this income (56%) is derived from the consumption of local chickens, and 42% from the use of pigs. Chicken are used on a day to day basis, where pigs are slaughtered during celebrations such as baptisms, funerals and weddings. Livestock is seldom butchered for sale. Table 14 summarizes subsistence income of households from the rearing and consumption of livestock.

Table 14: Summary of livestock owned by household at Golden Stream and average subsistence income.

| Type of livestock | Amount owned by household | Average weight (kg) | Price per live kilo | Subsistence income |
|---|---|---|---|---|
| Chicken | 25 | 2.5 | 5 | 438.67 |
| Turkey | 6 | 7.5 | 3 | 18.00 |
| Ducks | 4 | 2 | 2 | 2.13 |
| Pigs | 2 | 115 | 4 | 333.33 |
| **Total** | | | | 792.13 (BZD) |

Only six households (43%) reported to generate cash income from the sale of livestock (pigs and chickens). When sold, livestock can fetch high prices and contributes significantly to a household's cash income. Households who raised pigs and chickens for income generation earned an average annual income of 1,276.00 BZD (638.00 USD). This high income can be attributed to the fact that most households sold their animals when they had achieved maximum commercial weight.

### 4.2.4 Offsite income: income dependent on Ya'axché

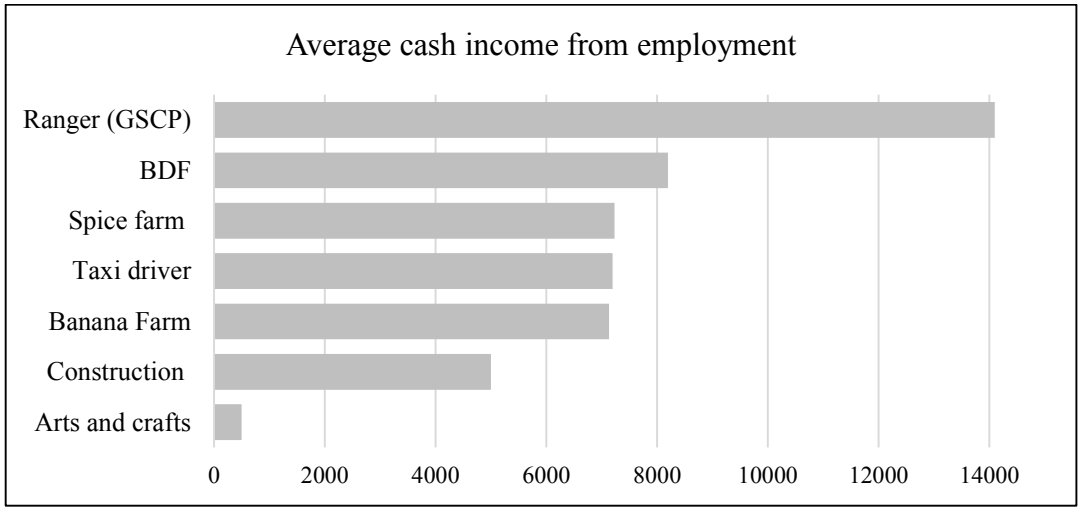



Figure 23: Formal employment of households at Golden Stream and average income earned from activity.

Fourteen households reported to have formal employment which was the main source of cash income. Four of these households participated in two forms of cash income generating activities. More than half of the participating households (71%) depended on the Belize Spice Farm & Botanical Gardens for wages. As part of the agreement the community had when the Belize Spice Farm was established, residents from Golden Steam are prioritized for hire. Most of the villagers work at the Spice Farm on a short contractual basis throughout the year. Most of the labor available is unskilled labor and therefore salaries are below the average wages in Belize. A laborer at the spice farms earns an average of 35 BZD (17.5 USD) as a daily wage.

Other sources of cash income included employment form construction, labor at the banana farms in Bladen, employment at the Belize Defense Force (BDF), free lancing, and the sale of traditional crafts (Figure 23). Two of the participating households (14%) had cash income directly dependent on the GSCP. These households had family members employed as rangers at the GSCP.

A household at Golden Stream earns an average annual cash income of 8,495.79 BZD (4247.90 USD) from participating in offsite income generating activities. Households with income dependent on the GSCP are higher than other sources of income. This may be partly due to the fact that it is a skilled job.

**Summary of cash-income**

Households at Golden Stream have three main sources of cash income: the sale of crops, sale of livestock, and offsite employment. Crops and livestock contribute only minimally to a household's cash income. Most of the household's produce from agriculture is used for subsistence. Offsite employment is the main source of cash income for households (Figure 24). cash income from offsite employment contributes significantly to a home's income. Earning cash income at Golden Stream has become increasingly important as homes have to cover expenses associated with education; especially secondary school education for children. Households at Golden Stream complained that in 2020 they received below average income because of the Covid-19 pandemic. The Belize Spice Farm and Botanical Garden reduced working days in March of 2020 due to the slow trickle of tourists.

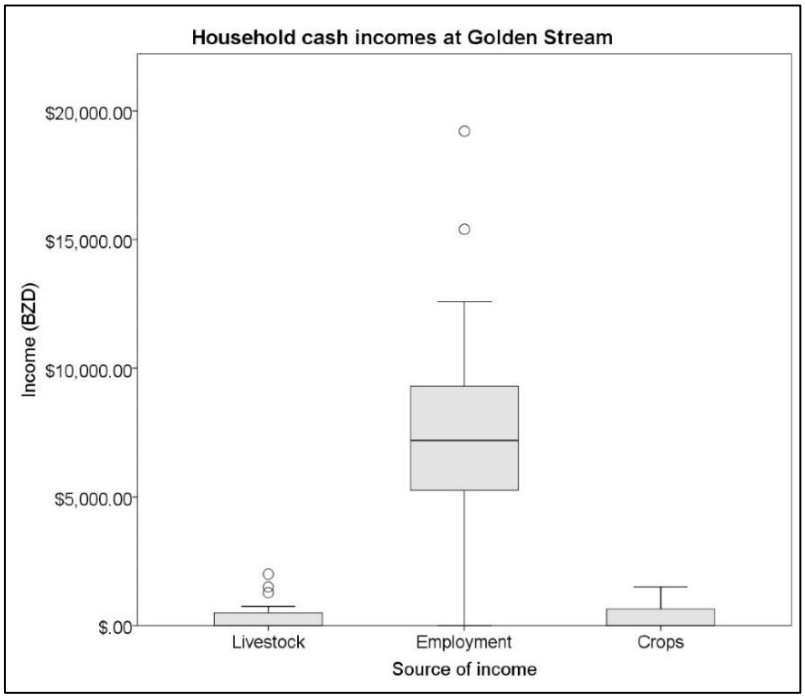



Figure 24: Comparison of household's cash income generation activities at Golden Stream.

### 4.2.5 Benefits arising from the management of the GSCP

Golden Stream has been one of the communities with which Ya'axché has been working since the establishment of the GSCP. Several community outreach and livelihood projects have been implemented in the community. Eight of the participating households (53%) indicated that they have received some benefit from these programs. Six forms of benefits were reported by the households (Figure 25). Most of these benefits were nontangible skills and knowledge shared with households through training and workshop sessions. All households received at least 2 forms of direct benefits from these programs. The most common benefit household received were training sessions in cacao agroforestry. From the five households who participated in these sessions, only one had successfully established a 1-hectare cacao plot. This farmer continues occasionally receives extension services from Ya'axché's extension officer. The other farmers reported that failure to adapt cacao agroforestry can be attributed to the remoteness of their farmlands. Access to these farmlands is limited during the rainy season. Additionally, the lack of running water at farmlands limits the survival rates of transplanted seedlings. Farmers also pointed out that cacao agroforestry requires high labor input—from activities such as pruning—which has discouraged many farmers from adopting agroforestry.

Four households received high school scholarships from Ya'axché. Two received full tuition scholarships for 4 years and 2 received book scholarships. Three households also participated in Ya'axché's fire training session with farmers from other communities. Fire trainings are aimed at reducing the incidence of escaped agricultural burns. All these households indicated that most of the knowledge they gained was already established traditional norm for conducting agricultural burns. However, they also expressed that now they try to conduct agricultural burns in teams to reduce the probability of escaped fires. From the two households which participated in beekeeping training, only one was producing honey for some years. The bee colonies were however lost to arson.

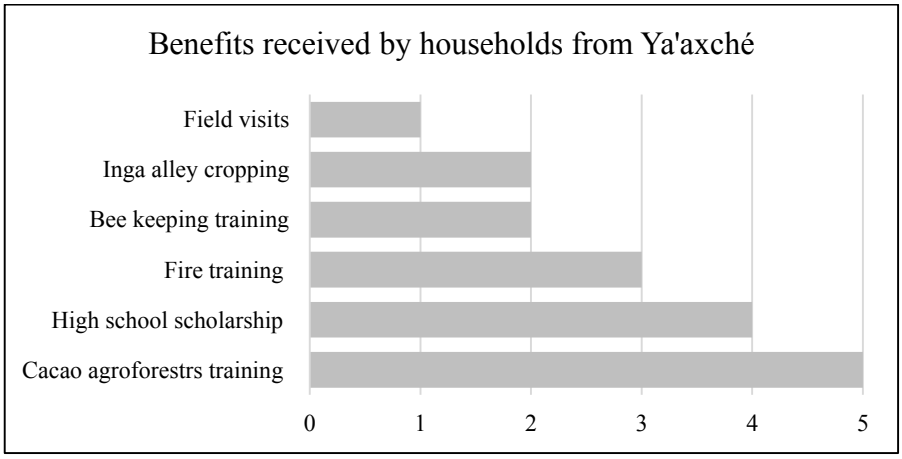



Figure 25: Benefits obtained by households from the management of the GSCP.

Inga alley cropping seeks to reduce slash and burn practice by promoting slash and mulching techniques. The inga tree; a nitrogen fixing plant, is planted in rows and is allowed to grow for approximately 2 years. When the canopy has closed, the branches are pruned and allowed to decay. Crops such as corn and beans can then be subsequently planted. The two households who had participated in these trainings, and who were given inga trees by Ya'axché, indicated that hey discontinued the practice after 2 years. Farmers complained that unlike *milpa* farming, inga alley cropping is labor intensive. During the growth period of the inga tree, rows have to be kept free of competing weeds and trees. Additionally, they would have to wait 2 years until the canopy of the rows have closed before they can produce any crops. Farmers indicated that this would require them to stop shifting cultivation because they would continuously plant in the same plot of land. They also felt that the method of farming is difficult to adapt because they would need to have large farming areas where they can plant their crops while the soil between the inga rows 'rests' for two years.

### 4.3 Case study 3: Indian Creek Village

Indian Creek Village is located 118 kilometers along the Thomas Vincent Ramos Highway, and about 8.5 kilometers west of the GSCP (Figure 9). The village is named after the Indian Creek which flows through the community and feeds into the Golden Stream. Indian Creek was established around 1968 by migrant families; a vast majority of whom were from Southern Belize, as well as from Guatemala. The village has a territory of about 3,000 acres (1,214 hectares) over which it holds communal ownership since 2009. Most of this communal lands and forests are dedicated to subsistence farming. According to the *Alcalde*, the village currently has about 600 inhabitants and about 245 households. Indian Creek is a predominantly Kekchi Maya community. When compared to Medina Bank and Golden Stream, Indian Creek is the largest community and is visibly more developed than the other communities.

Indian Creek extends for approximately 4 kilometers along the Thomas Vincent Ramos Highway. Most homes at Indian Creek are built with material collected from the forest. Traditional homes with dirt floors are less common in Indian Creek than at Golden Stream or Medina Bank. Indian Creek is not connected to the national electricity grid, although the power lines have been installed. Potable water is distributed to residents via a rudimentary water system which draws water from an underground well with a diesel pump. The Nim Li Punit Archaeological Reserve can be found in the outskirts of the village. The reserve is managed by the National Institute of Culture and History. Residents of Indian Creek are allowed to operate

small art shops in premises of the Mayan Site. Four churches are placed in the community, as well as a community center where public events are held. A government run school also operates in the community. Several small tourism businesses are operating at Indian Creek.

Two families offer agrotourism experiences to locals and international tourists. The experiences range from cacao farm tours, chocolate making, traditional cooking and hiking within the community forests. The farmers also offer traditional craft for sale, as well as coffee and chocolate. There are three women's group in the community. These groups offer cultural experiences such as traditional cooking, traditional dancing, Mayan ceremonies, and chocolate making. Ya'axché coperates with these women's group to cater for student and research groups. All these groups also have gift shops which offers locally made traditional handcrafts.

### 4.3.1 Demography of participating households

Thirty-six households from Indian Creek participated in the household surveys. Most participating household leaders were males (72%). The average age of household leaders was 45. Seventy-five percent (27 household leaders) of these participants had primary school education, 17% had secondary education and the remainder did not have any formal education. Household sizes ranged from 2 to 12 individuals, with the average household having 5 members. Most of the male household leaders (72%) indicated that they practice subsistence farming. However only half (13) of these household leaders dedicated their time entirely to farming, and the others divided their time between farming and other income generating activities (see Table 15). Six household leaders depended entirely on offsite income. Two of the female household leaders indicated to partake in income generation through the work in the women's group. All the participating households identified as Kekchi Maya.

Table 15: Occupation of household leaders at Indian Creek.

| Occupation | Frequency | Percent |
|---|---|---|
| Farmer | 13 | 36 |
| Farmer/entrepreneur | 2 | 6 |
| Farmer/laborer | 1 | 3 |
| Farmer/tourism business | 2 | 6 |
| Farmer/bus owner | 1 | 3 |
| Farmer/bush doctor | 1 | 3 |
| Farmer/tourism worker | 1 | 3 |
| Farmer/tour guide | 1 | 3 |
| Farmer/freelancer | 4 | 11 |
| House wife | 4 | 11 |
| House wife/women's group | 2 | 6 |
| Tour guide | 1 | 3 |
| Freelancer | 3 | 8 |

n=36

All households owned land in the community. Eight of the households (22%) owned only house lots in the village. These households indicated that the exponential growth of the community has led to a shortage of land that is accessible throughout the year. Granted, some of these household still practiced some form of farming on family member's land or rented from relatives or neighbors. Most of the households owned farm lands. Like the other villages in this study, there were two forms of ownership: communal land and lease title ownership. More than half of households who owned farming lands (64%) has leased title, while the remainder had communal tittles. Farm lands held under leased titles were generally larger; an average size of 16.6 hectares. Communal farm lands had an average size of 8.8 hectares. The area cultivated, under follow forest and high forest varied according to land size (Figure 26). The land uses proportions however were similar: 25% under cultivation, 20% as follow forest, and more than 50% with high forest.

Farmlands are located in the outskirts of the community. Traditional shifting cultivation, also called *milpa*, is the most common form of farming practiced by households. Other form of farming includes inga alley cropping and agroforestry. Ten of the farmers owned cacao agroforestry plots and inga alley cropping plots. These plots were small, averaging at 1.1 hectares. Traditional shifting cultivation has been substituted by inga plots and agroforestry where permanent crops are cultivated.

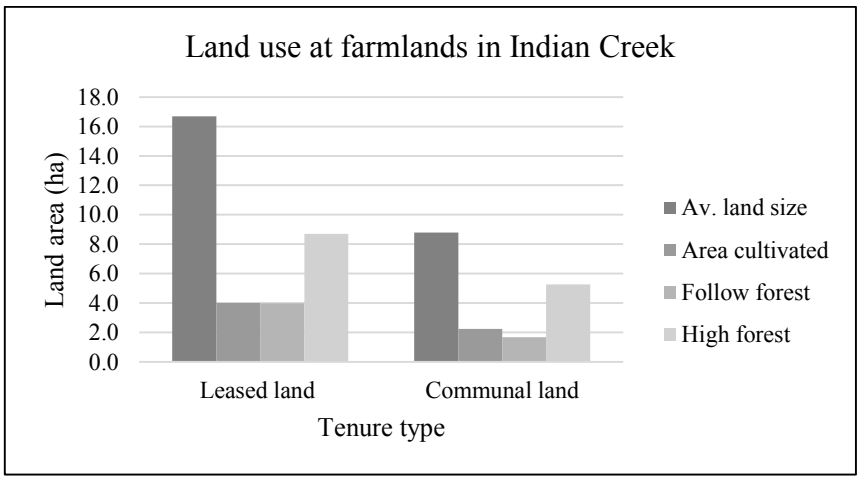



Figure 26: Form of farm land ownership at Indian Creek and their status.

### 4.3.2 Forest utilization: subsistence and cash income

All participating households depended on the forest for either construction material, edible forest products, fuelwood, medicinal plants, and other NTFPs. The utilization of these forest products was not uniform across households. None of the households extracted these forest materials from the GSCP. Forest products were exclusively extracted from communal lands and forests. Communal lands here refer to house lots within the village, farming lands under

lease and communal property, as well as other forested areas which do not have ownership. Residents of Indian Creek can access most resources in lands without ownership for free. The subsistence logging of timber hardwood species is permitted. A logging petty permit is given to villagers by community leaders at a fee of 16 BZD (8 USD). There are no limits to cutting size of timber trees.

**Construction material**

Construction material used by households at Indian Creek were similar to the other villages in this study. Cohune fronds, poles for rafters, posts, lumber planks and vines were used as contruction material (Figure 27). When compared to other communities, vines, posts and lumber planks were used less frequently and in lesser quantities. Many households have substituted these material with concrete post, cinder block walls and tin roofing. The longevity of modern construction material is the main reason why forest materials have been substituted. Although this can also be attributed to the fact that households in Indian Creek have higher cash incomes when compared to the other communities (see Chapter 5). Like Medina Bank and Golden stream, construction material is collected from back yards, farm lands and community forests.

Figure 27: Construction of a typical home at Indian Creek.

The most frequently replaced forest construction material are those utilized for roofing. These materials are replaced every 7 years, although some households indicated that they can last longer. The average household utilizes 848 cohune fronds for thatching. Four households indicated that they used bay leaf palm fronds (*Sabal morrisiana*) as thatching material. Bay leaf

palms are however not abundant in the area. The roofing frame of homes consists of an average of 78 poles and beams of different dimensions. Only 2 households at Indian Creek reported to use of vines as fasteners for the cohune fronds on the rafters. The other households utilized tying wire and nylon strings as fasteners. A household used an average of 12 posts for constructing the main frame of their homes. The dimension of these posts varied. Sapodilla (*Manilkara zapota*), rosewood (*Dalbergia stevensonii*), yemeri (*Astronium graveolens*), madre cacao (*Gliricidia sepium*) and Jobillo (*Astronium graveolens*) are the most common tree species used as posts. The replacement time for these posts ranged from 12 to 20 years. Thirteen of the participating households (36%) did not use lumber planks for walls. The walls of these homes were made of commercially produced wooden siding or concrete cinderblocks. Homes who used lumber planks as walls, utilized an average of 79 lumber planks. The dimension of these wooden planks varied.

Households at Indian Creek receive an average of 1,420.56 BZD (710.28 USD) of annual subsistence income from the utilization construction material from the forest. Subsistence income from forest construction material varied significantly between household. This can be attributed to the fact that not all households utilized the same types of construction material. The price of most forest construction materials were similar to the other communities, except for the poles and beams for A-frames and cohune fronds. Cohune fronds fetch a price of 0.50 BZD (0.25 USD) and A-frame poles 400 BZD (200 USD) at Indian Creek. The price summary of the average quantity and price per unit of each material can be found in Table 16.

Table 16: Summary of construction material, average quantity used and average price per unit.

| **Type of construction material** | **Average quantity** | **Average price (BZD)** | **Average subsistence income** |
|---|---|---|---|
| Cohune fronds | 848 | 0.50 | 424.17 |
| Bay leaf palm fronds | 41 | 1.00 | 40.97 |
| Poles for A frame | 78 | 400.00 | 522.22 |
| Rolls of vines | 10 | 5.00 | 4.86 |
| Posts | 12 | 10.00 | 15.83 |
| Lumber planks | 79 | 7.50 | 412.50 |
| **Total** | | | 1420.56 (BZD) |

**Edible forest products and bush meat**

All 36 participating household indicated that they collected edible plants form communal forests. Jipijapa palm shoots, cohune cabbage, and pacaya palm inflorescence were the most common edible plants consumed. These plant products were collected from follow forest and forested areas at farm lands, as well as from community forests without ownership. Jipijapa palms are sometimes grown in home gardens and backyards. Pacaya palms are less common

and therefore collected in the higher forested areas of the community. Households consume an average of 35 kilograms of jipijapa shoots, 12.5 kilos of cohune cabbage and 4 bundles of pacaya (Table 17). Households at Indian Creek receive an average of 299.67 BZD (149.84 USD) from the consumption of edible plant material.

Only two household reported to generate cash income from the sale of edible plant products (jipijapa shoots). The households sold an average of 75 kilograms in a year, generating an income of 225 BZD (112.50USD).

Table 17: Summary of edible forest products, average quantity and price per unit consumed by household at Indian Creek.

| **Edible forest product** | **Average quantity used** | **Price per unit (BZD)** | **Average subsistence income** |
|---|---|---|---|
| Jipijapa shoot (kg) | 35 | 6.00 | 207.83 |
| Cohune cabbage (kg) | 12.5 | 8.00 | 89.33 |
| Pacaya (bundles) | 4 | 1.00 | 2.50 |
| Armadillo (kg) | 2 | 7.50 | 3.33 |
| Gibnut (kg) | 60 | 12.00 | 185.00 |
| Peccary (kg) | 60 | 10.00 | 125.00 |
| Deer (kg) | 40 | 14.00 | 93.33 |
| **Total** | | | 706.33 (BZD) |

More than half of the participating households (53%) partook in hunting. Hunting at Indian Creek is a family affair where teams of up to 5 persons go on hunting trips at least once a month. The same large mammals hunted at Golden Stream were targeted at Indian Creek. Gibnut, armadillos, peccary and white tailed are the main bush meat sought after. The hunting style at Indian Creek is similar to those used in other communities. Gibnut and Peccary were the most frequently hunted species; averaging annually about 2 and 3 kills per household respectively. Armadillos and deer average at about 1 hunted individual per year. Households indicated that peccary are the most frequent and abundantly hunted game because they forage in packs. As is the case with other communities, a hunt's kill is usually shared among the hunting team and their family members. The price per kilogram of bush meat are similar to those in other communities (Table 17); although none of the households reported any cash income from hunting. A household at Indian Creek receives an average of 406.67 BZD (203.34 USD) from the consumption of bush meat. This subsistence income varied significantly amongst household because not all of them actively hunted for bush meat.

The collection of edible plant material and hunting of game species provides families at Indian Creek with 706.33 BZD (353.17 USD) of subsistence income. Households which participated in hunting observed higher subsistence incomes.

**Other NTFPs**

Nonedible, not timber forest products (NTFPs) were also collected from community lands and forests by households. Leaves from the waha plant (*Calathea lutea*) were collected to be used for cooking purposes. Most of the households (94%) collected waha leaves from their farmlands and along the riparian forest of the Indian Creek. On average, a household utilizes 482 waha leaves in a year. Waha leaves play an important role in the local economy of Indian Creek, especially for the 3 Women's group. Waha leaves are used for preparing local dishes which is not only part of their daily activities, but also catered to tourists. Households at Indian Creek received an average subsistence income of 45.57 BZD (22.79 USD) from the collection and utilization of waha leaves (Table 18). The variation of waha leaves used by households varied significantly; especially at homes which were part of the women's group who catered for tourism. None of the households reported to the sale of waha leaves.

Table 18: Summary of NTFPs annually used by households, the average quantity and price per unit.

| NTFP | Average quantity used | Price per unit (BZD) | Average income |
|---|---|---|---|
| Waha leaves | 482 | 0.10 | 45.57 BZD (subsistence income) |
| Jijpijapa leaves (kg) | 21.4 | 12.00 | 149.44 BZD (cash income) |
| Cohune nuts | 50 | 3.00 | 8.33 BZD (cash income) |

Jijpijapa palm (*Carludovica palmate)* leaves were collected by 14 households (38%). Jipijapa leaves were collected in fallow forests. The households collected an average of 21.4 kilograms of jipijapa leaves. Jipijapa leaves are defoliated and the fibers dried for weaving traditional crafts. Most households sold the leaves to groups or other community members who weave the fibers into baskets and ornaments (Figure 28). These crafts are sold at local markets in the nearby town of Punta Gorda; at other tourism villages such as Hopkins and Placencia; and also to Women's gift shops in the community. One household reported to collect nuts from the cohune palm to carve jewelry which was also sold at the women's group gift shop.

Households which sold jipijapa leaves and cohune nuts earned an average of 166.11 BZD (83.06 USD) of cash income. This cash income does not account for investment in time and labor.

Figure 28: Baskets (left) and hair ornaments (right) woven from jipijapa leaves (Source: Indian Creek Mayan Arts Women's Group).

**Fuel wood**

All participating households collected fuelwood for cooking. Most of the households (32 of 36 ~89%) gathered their fuelwood during the dry season by pickup loads. A pickup load is estimated to hold an average volume of 1.9 $m^2$ of fuelwood. An average of four pickup loads were gathered in the dry season. This amounted to an average consumption of 8.4$m^2$ of fuelwood during the year. Four household reported to collect fuelwood by bundles. The average fuelwood collected by bundles were similar to those collected in pickup loads. Fuel is collected at agricultural clearings, along farm roads, at community forests, as well as clearings in the village.

Table 19: Summary of fuelwood collection and average subsistence income from the collection and utilization of fuelwood.

| | **Form of collection** | **Average volume per year** | **Average household subsistence income** |
|---|---|---|---|
| Weekly | Bundles | 13.68 | 585.50 |
| Periodically | Pickup load | 8.31 | 355.77 |
| **Average** | | | 381.30 (BZD) |

Based on reports from the community, a cubic meter of fuel fetches about 42.80 BZD (21.40 USD). Granted, households at Indian Creek receive an average of 381.30 BZD (190.65 USD) of subsistence income from the collection and consumption of fuelwood. Households which collected fuelwood on a weekly basis gathered more than households who did so periodically. These households also observed higher subsistence income from the collection and utilization

of fuel wood (Table 19) None of the households reported to generate any form of cash income from the sale of fuelwood.

**Summary of subsistence and cash income from forest utilization.**

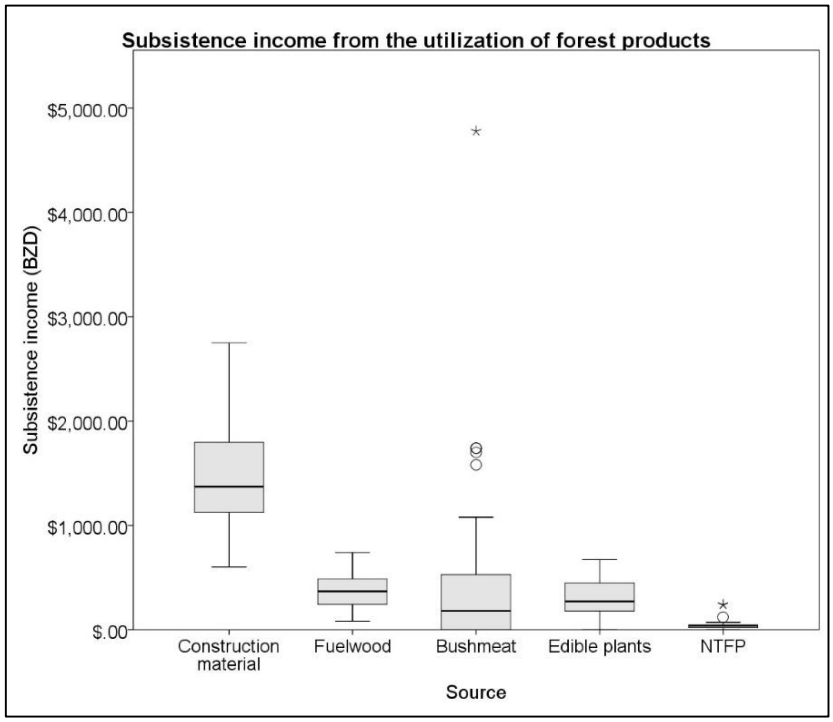



Figure 29: Summary of subsistence income of households at Indian Creek from construction material, fuelwood, bush meat, edible plants and NTFPs.

Households at Indian Creek received subsistence income from the extraction of construction material, fuelwood, bush meat, edible plants as well as from other NTFPs (Figure 29). This amounted to an average subsistence income of 2,637.09 BZD (1,318.55 USD) for a year. Fifty-three percent of this subsistence income is derived from the utilization of construction material, 20% from bush meat, 14% from fuelwood, 11% from edible plants, and only 2% from NTFPs (Figure 30). When these subsistence incomes are compared, subsistence income from NTFPs is significantly lower than subsistence income received from edible plants, fuelwood, and construction material (significance between 0.000 and 0.001). Likewise, subsistence income from construction material was significantly higher than those obtained from bush meat, edible plants, and fuelwood (significance of 0.000). See Annex 5 for the nonparametric kruskal-wallis pairwise comparisons.

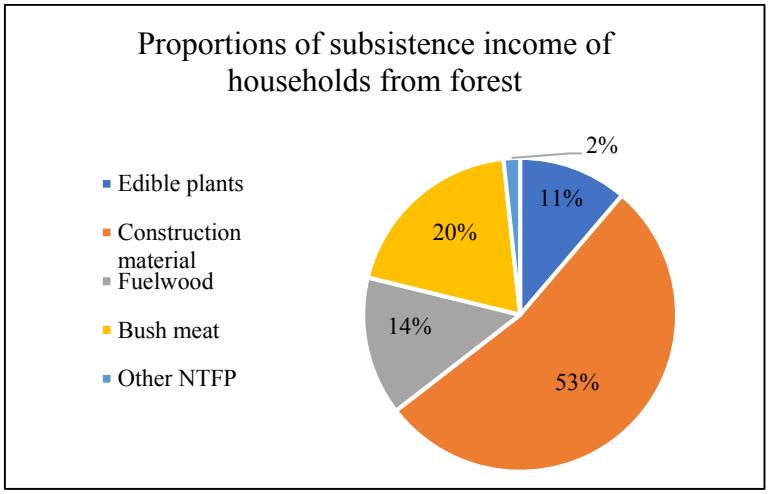



Figure 30: Proportions of subsistence income received from construction material, fuelwood, bush meat, edible plants and other NTFPs.

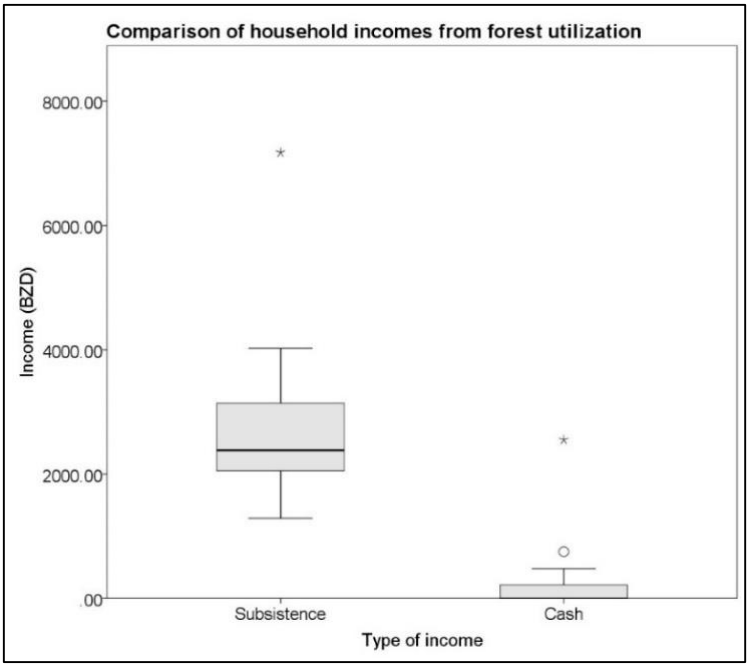



Figure 31: Comparison of cash and subsistence income from the utilization of forest products by households at Indian Creek.

Cash income from the utilization of forest products was also reported by households in Indian Creek. When cash income from forest products is compared to the subsistence income, subsistence income contributed more significantly to the livelihood of households at Indian Creek (Figure 31). This is due to the fact that not all household participated in income generation from the sale of forest products.

### 4.3.3 Agriculture: subsistence and cash income

**Milpa**

Shifting cultivation, otherwise known as *milpa* farming is the main source of subsistence food at Indian Creek. Thirty of the participating (83%) households produced agricultural crops using this traditional method of farming. White, yellow and black corn varieties are the most

cultivated crops. Farmers plant corn twice a year. Similar to Medina Bank and Golden Stream, farmers at Indian Creek follow the rainy season for the cultivation of corn and crops. Farmers at Indian creek cultivate 3 varieties of beans: red kidney, black and pinto beans. Only a small fraction of corn and beans produced are sold at the local markets. Besides being the main source of food, corn is also used to feed livestock. Farmers produce less beans. Bean production is rarely enough and households usually have to buy from other villages. Plantains, Cassava and Cocoyam are also cultivated throughout the year by farmers. Most of the ground food produce is sold at the local markets. Other crops such as pumpkins, hot peppers, and okro are cultivated in backyard gardens and also at farm lands.

Households at Indian Creek receive an average of 874.63 BZD (432.31 USD) from subsistence use of agricultural crops. Table 20 summarizes the average quantity of crops utilized for subsistence by household, and the price per unit of crop. Corn makes up 78% of this subsistence income; of which white constitutes 63%, yellow 12% and black 5% (Figure 32). Subsistence from other crops accounted for the remaining 22%.

Table 20: Summary of crops produced by households, the average quantity used and their market price per unit.

| **Crop** | **Average quantity used** | **Price per unit** | **Average subsistence income (BZD)** | **Average cash income (BZD)** |
|---|---|---|---|---|
| White corn (kg) | 819 | 0.90 | 552.78 | 52.22 |
| Yellow corn (kg) | 139.4 | 0.90 | 102.22 | 0.00 |
| Black corn (kg) | 108.3 | 1.50 | 43.75 | 0.00 |
| Red kidney beans (kg) | 53.1 | 3.00 | 29.51 | 0.00 |
| Black beans (kg) | 72.5 | 2.00 | 36.25 | 4.17 |
| Pinto Beans (kg) | 25 | 1.00 | 1.11 | 0.00 |
| Pumpkin (kg) | 12.7 | 2.00 | 8.47 | 0.00 |
| Hot pepper (kg) | 5.3 | 3.00 | 3.51 | 3.89 |
| Plantain (bunches) | 11 | 7.50 | 37.50 | 5.21 |
| Cassava (kg) | 17.9 | 4.00 | 25.83 | 30.83 |
| Cocoyam (kg) | 23.6 | 3.00 | 31.46 | 39.17 |
| Okro (kg) | 16 | 2.00 | 2.22 | 0.28 |
| **Total** | | | 874.63 | 135.76 |

Fifteen households reported to earn cash income from the sale of crops. This income was marginal when compared to subsistence income. Households earned an average of 135.76 BZD (67.88 USD) during the last year from the sale of crops at the local markets. Cash income from the sale of crops varied between households. More than 50% of this income is obtained from the sale of ground foods; 29% from cocoyam and 23% from cassava. The sale of surplus white corn made up 38% of cash income from the sale of *milpa* crops.

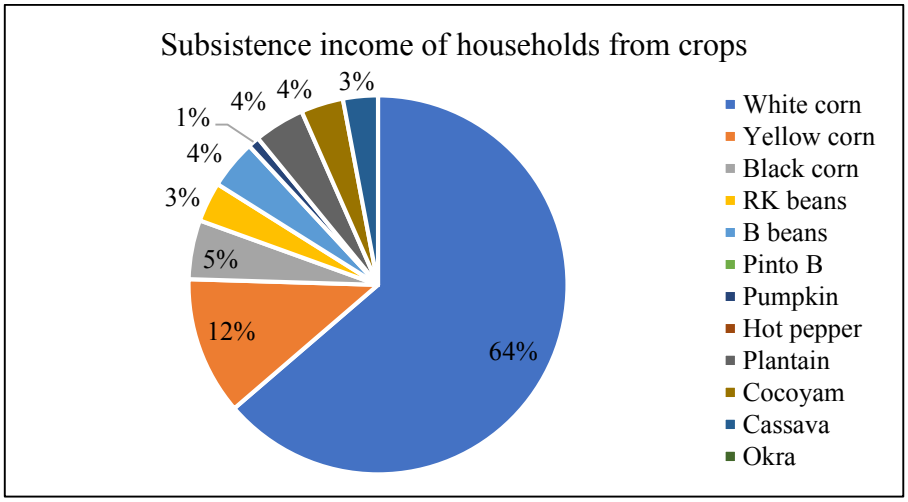



Figure 32: Proportional contribution of crops to subsistence income of households at Indian Creek. RK beans: red kidney beans, B beans: black beans, Pinto B: pinto beans.

**Livestock**

A vast majority (89%) of participating households owned some form of livestock. Households owned an average of 20 local chickens, 2 turkeys, 6 ducks and 1 pig. One household reported to have 10 heads of cattle. When compared to Medina Bank and Golden Stream, households did not own as many pigs. This is primarily due to the fact that Indian Creek is more populated. The rearing of pigs within the community is limited by communal rules because it can become a nuisance to neighborhoods. Livestock was used for both subsistence and the generation of income. All livestock were sold at live prices (see Table 21).

Table 21: Summary of type of livestock, their average weight and price per unit weight.

| Type of livestock | Amount owned by household | Average weight (kg) | Price per live kilo (BZD) | Average subsistence (BZD) | Average cash income (BZD) |
|---|---|---|---|---|---|
| Chicken | 29 | 2.5 | 5 | 434.86 | 271.81 |
| Turkey | 2 | 8 | 3 | 15.83 | 0.00 |
| Ducks | 6 | 2 | 2 | 9.53 | 22.78 |
| Pigs | 1 | 200 | 4 | 157.64 | 140.97 |
| Cattle | 10 | 400 | 5 | 0.00 | 222.22 |
| **Total** | | | | 617.86 | 657.78 |

Households at Indian Creek receive an average of 617.86 BZD (353.93 USD) of subsistence income from the subsistence use of livestock. Seventy percent of this subsistence income was derived from the utilization of local chickens, and 25% from pigs. Subsistence income from livestock varied among households because not all owned the same number of livestock. Interestingly, cash income generated from the sale of livestock was similar to the quantity utilized for subsistence. Half of the households who owned livestock indicated that they generated cash income from the sale of livestock. On average they generate an annual income

of 657.78 BZD (328.89 USD). Income generation varied amongst households, especially for the household which practiced cattle ranching exclusively for commercial purposes.

**Agroforestry**

Agroforestry is widely practiced at Indian Creek. Eleven of the participating households indicated to have an agroforestry plot where they have cultivars of cacao, coffee, timber species and other fruit trees. All these households indicated that they adopted cacao agroforestry after Ya'axché conducted several agroforestry workshops and training sessions. At the conclusion of the training sessions, Ya'axché provided them with cacao, coffee, fruit trees, and timber tree seedlings for the establishment of their plots. Ya'axché has since been conducting occasional follow-up and extension services. Eight of these households established their plots more than 5 years ago and have since been harvesting cacao. Only Four households indicated to be actively harvesting coffee from their plots.

Table 22: Cash income of households from agroforestry products.

| Agroforestry product | Amount produced (kg) | Price wet beans | Price dried beans | Average cash income (BZD) |
|---|---|---|---|---|
| Cacao | 609.36 | 2 | 6 | 1545.83 |
| Coffee | 35.5 | 5 | 10 | 241.67 |
| **Total** | | | | 1659.38 |

The average size of the agroforestry plot was 2.7 hectares. Productive plots were yielding an average produce of 609.36 kilos of cacao beans on an annual basis. Most of the farmers sold "wet" cacao beans to the Maya Mountain Cacao company. Maya Mountain Cacao is a company dedicated to bulk buying, post-harvest processing and export of cacao beans. Wet cacao beans fetch a price of 2 BZD (1USD) per kilo. Dried and fermented cacao fetches a higher price of 6 BZD (3 USD) per kilo. The fermentation and drying process is however labor intensive so most farmers opt not to do so. Only two farmers sold cacao bean in its dry and fermented form. Coffee is also sold in its freshly harvested form to local women's group, resorts and gift shops. Households were producing an average of 35.5 kilos of wet coffee beans and were selling them for 5 BZD (2.50 USD) per kilogram. Households partaking in agroforestry earned an average of 1,659.38 BZD (829.69 USD) of cash income exclusively from the sale of cacao and coffee beans (Table 22). This income does not discount inputs in family labor, time and resources.

**Bee keeping**

Beekeeping in the Maya Golden Landscape has been one of the sustainable livelihood initiative promoted by Ya'axché. Five households were part of this initiative some years ago, however only Four households were actively producing honey. Two of the households abandoned their bee colonies because it was too labor intensive and also needed financial assistance for

expanding their hives. Farmers owned an average of 5 colonies, or in their terms “boxes” of bees. Harvesting of honey occurs during the dry season; usually between April and May. Bee hives produced an average of 183.3 kilograms of honey on an annual basis. Farmers reported that honey fetches about 8 BZD (4 USD) per kilogram. On an annual basis, farmers who practiced bee keeping earned cash income of 1,466.67 BZD (733.34 USD) from honey production.

### 4.3.4 Offsite income

Thirty-three (92%) of the participating households performed offsite activities which generated cash income. Half of these households conducted 2 activities for the generation of income. A household at Indian Creek earns an average annual cash income of 10,173.06 BZD (5,086.53 USD) from partaking in several offsite income generating activities. Nine major forms of income generation were identified at Indian Creek (Figure 33). The most common form of cash income generation activity households participated in was the sale of traditional crafts. The boom of cruise tourism in the southern districts of Belize has created a niche market for the sale of traditional crafts in Indian Creek. Handmade crafts such baskets, jewelry, stone and wooden carvings, traditional clothing and bags are sold at gift shops at the Nim Li Punit Mayan Archaeological Site. Households reported that while some of these crafts are locally made, most are outsourced from other nearby communities. Despite being the most common cash income generating activity, the sale of traditional crafts contributing between 10 to 15 percent of a household’s annual earnings.

Employment in the tourism sector was the second most common economic activity households participated in. In many of the households, employment in tourism was the sole cash income earner. Employment in this sector ranged from bartending, tour guiding, and resort up keeping. Salaries from working in the tourism sector generated more cash income than any other form of activity.

Catering and offering cultural tourism and experience at Indian Creek was the third most common cash income generating activity of households. Cultural tourism and experience is offered by three women’s group at Indian Creek: The Ixchel Women’s group, Indian Creek Mayan Arts Women’s Group and the Marigold Women’s Cooperative. These groups offer cultural experiences such as Mayan ceremonies, traditional meals and dances, as well as chocolate making. Households also reported that freelancing is another major wage earner. For instance, during data collection at Indian Creek, many households had temporary jobs with the Belize Electricity Company which was installing power lines and electricity infrastructure in the village.

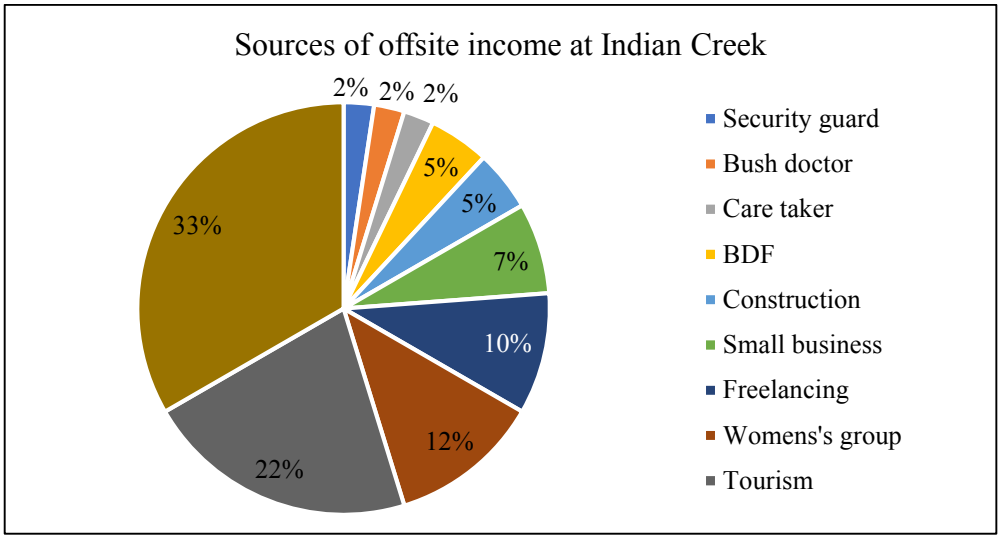



Figure 33: Income generating activities of households at Indian Creek. BDF: Belize Defense Force.

**Income dependent on Ya'axché**

Chiquin's Family Farm and Akte il Ha Cacao Farm are two family owned businesses which offer agro tourism experiences to local and international tourists. These family run businesses are known their educational tours. Their cacao, sustainable farming, farming, birding, and hiking tours are popular attractions to local schools. These small businesses frequently partner with Ya'axché to offer outreach experiences to school children during the annual Ya'axche summer camps, and also research student groups. While these families were reluctant to share their financial details, and the fraction which is dependent on partnerships with Ya'axché, they reported that at least 15% of their annual cash income depends on partnerships with Ya'axché. Two women's group also have similar partnerships with Ya'axché. The "Maya Cultural Visit" and "Maya Healing" tours are part the 'Two Day Maya Immersion' and 'Four-Day Maya Golden' tour packages offered by EcoTourism Belize. During these tours traditional cooking, dancing, weaving. chocolate making, and healing experiences are offered to tourists. Seven households reported to be part of these women's group. The contribution of income directly dependent on these tours varied amongst households. This is because the groups organize and work on a rotational basis. One of the participating household's cash income depended entirely from this activity. On average, these households received an annual cash income of 2,616.67 BZD (1,308.34 USD), which represented about 39% of the household's earnings entirely dependent on tours conducted in partnerships with Ya'axché.

**Summary of cash incomes**

Households at Indian Creek generated cash income from 4 major sources: the sale of forest products, livestock, and crops; as well as from conducting other offsite income generating activities. A household at Indian Creek earns an average cash income of 11,573.40 BZD from

these various income generating activities. When income generating activities are compared, offsite income generating activities contribute more significantly to a household's earnings (Figure 34).

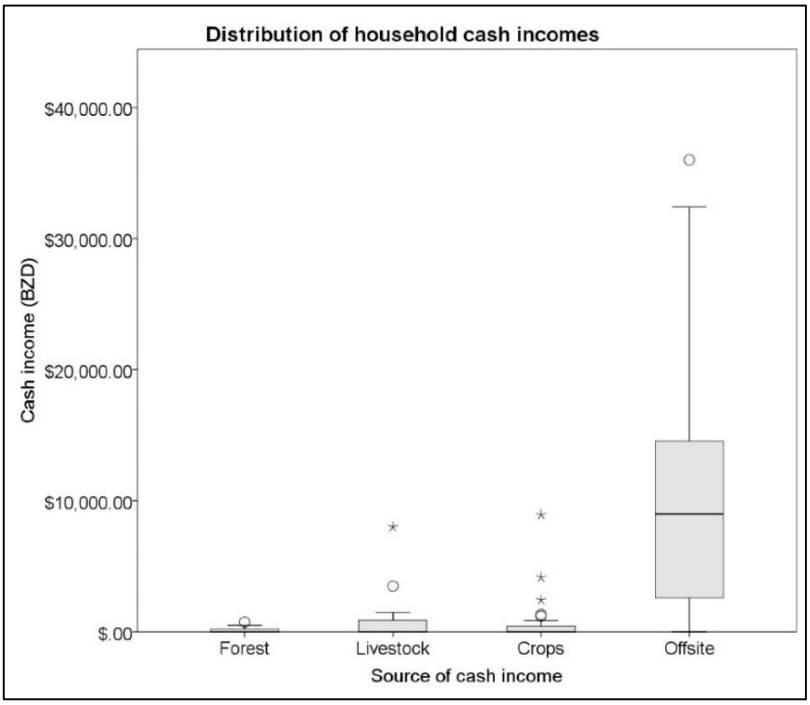



Figure 34: Sources and distribution of cash income of households at Indian Creek.

### 4.3.5 Benefits arising from the management of the GSCP

Several community outreach and livelihood projects have been implemented by Ya'axché at Indian Creek. A vast majority of these projects have sought to increase knowledge and provide capacity building for children, women and farmers at Indian Creek. Sixty-one percent (22 households) reported to have received some form of benefits in the last 5 years form the implementation of projects, workshops, trainings and community outreach. Households reported 14 forms of benefits resulting from the management of the GSCP (Figure 35). All these households received at least 2 direct benefits, the most common being cacao agroforestry training. From the 12 households which participated in agroforestry trainings and workshops during the last five years, 11 had adopted the agroforestry practices. The adoption of agroforestry was facilitated by Ya'axché providing startup seedlings (cacao, coffee, fruit trees and timber species), as well as seedling at a reduced price. Farmers however expressed that the frequency of extension services has dropped over the years. They attributed this to the fact that Ya'axché has been actively engaging other communities in similar climate smart farming; the most recent being an agroforestry concession in the Maya North Forest Reserve. The farmer who had not successfully established his cacao plot said that low quality of soil at his farm and remoteness of the farm contributed to its failure.

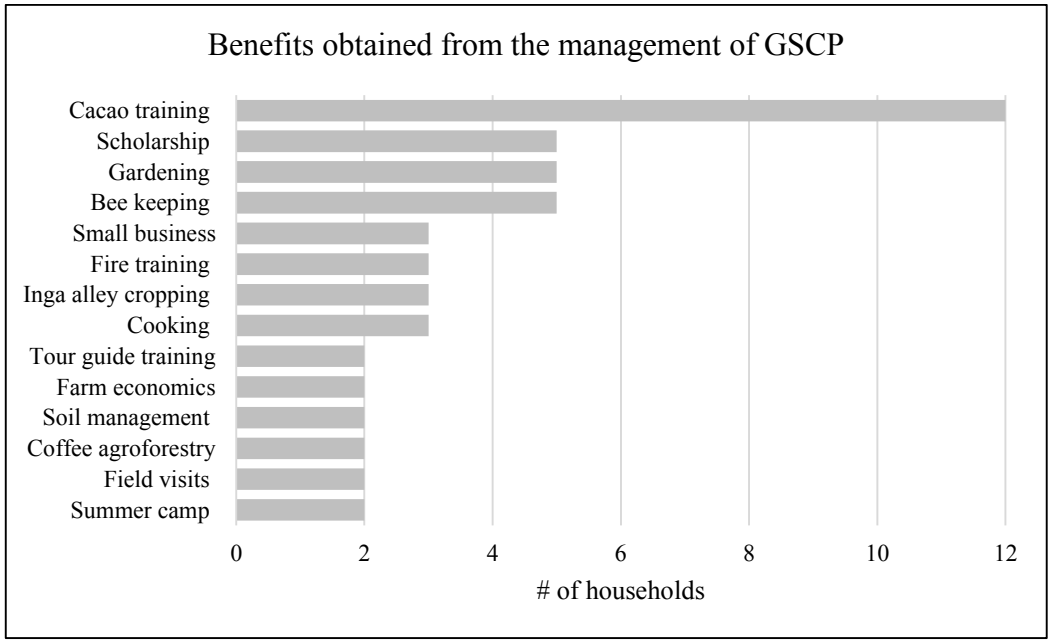



Figure 35: Benefits received by households resulting from the management of the GSCP.

Scholarships, training in gardening techniques, and beekeeping trainings were the second most common benefit households obtained from programs implemented by Ya'axché. This training was particularly important to the women's group who produce their own vegetables for the catering services they provide. Farmers also gained experience in composting and vegetable gardening. Adopting vegetable gardening is however a challenge because of the remoteness of farm lands (inaccessible during the rainy season), as well as the lack of potable water. Two households received full tuition school scholarships from Ya'axché. Three households received high school book scholarships. These scholarships are awarded to underprivileged families for 4 years.

Five farmers participated in bee keeping and training and field exchanges. During these trainings, farmers were taught apiculture techniques such as hive maintenance, colony splitting, hive framing and honey harvesting and processing. Harvested honey is sold in the local markets. Two farmers have not been able to expand their colonies because they did not have the finances to invest in new frames, wax sheets and boxes. One farmer had discontinued beekeeping because it was too labor intensive for his age.

Training in small business management, cooking, inga alley cropping and fire management were the third most prevalent benefit households received from Ya'axché. Training in small business management and cooking were targeted at women's groups. These projects sought to improve the management of their small enterprises. All the participating women indicated that knowledge gained in financial management, and the pricing of their services and products has significantly contributed to the long term financial sustainability of their groups. Inga alley

cropping and fire management trainings targeted farmers. Fire trainings aimed to improve the use of fire as a clearing tool at farm lands. According to farmers, fire management trainings have been useful at improving the collective and coordinated burning of agricultural lands. The opinion of farmers over inga alley cropping were similar to those at Golden Stream. One farmer reported that his corn production was comparable to a newly cleared forest. But given the investment in labor and the fact that the practice implies them having a permanent cultivating plot, inga alley cropping is a cultural change him and his family are not willing to make. Another farmer indicated that he would have appreciated more guidance from Ya'axché because after the establishment of the plots he had not received further extension services. This resulted in him abandoning his inga plot.

Two households received training in tour guiding, farm economics, soil management, coffee agroforestry; participated in field visits to demonstration farms; and had children participating in Ya'axché's annual summer camps.

# CHAPTER FIVE

## 5. Consolidating and comparing the embedded cases

### 5.1 Direct use values from forest utilization

All the communities in this embedded case study received direct use values from the utilization of forest products. Four major forms of forest resource utilization were observed: collection of forest construction material; collection of edible forest products and the hunting of game species; collection of fuel wood; collection of forest material for medicinal purposes; and the gathering of other forms of NTFPs. None of these direct use values were obtained from the GSCP; all the participating households reported that community forests were the primary source of these forest resources. For the purpose of reporting, this direct use values have been split into two forms; subsistence income and cash income. Subsistence and cash income from these forest products varied between households in communities, as well as across the communities.

The type of forest product gathered by households in the communities varied. These differences in forest resource use were captured in the variance of resource use within the communities (Annex 6). This is also reflected in the non-normal distribution of gathered data and the detection of several outliers. The collection of construction material from the forest contributed to most of household's subsistence income in all the communities—at least 50% (Figure 36). Food from the forest (bush meat and edible plants) were the second most important materials gathered from the forest (between 27% to 35% of forest subsistence income). This was followed by fuel wood and then by NTFPs. Although average subsistence income from forest products varied amongst communities, only the collection of construction material was statistically different amongst them. A nonparametric Kruskal-Wallis test revealed that subsistence income from the collection of construction material was significantly lower at Medina Bank than at the other communities (Table 23). This is attributed at the fact that timber used for the construction of homes were not included in the calculations; primarily because the origin of the timber cannot be determined. Lower subsistence incomes at Medina Bank from construction material can also be partly attributed to use of other construction material such as vines and bay leaf at Golden Stream and Indian Creek.

Table 23: Non-parametric Kruskal-Wallis pairwise comparison of subsistence income from construction material of communities.

| Pairwise comparisons | Test statistic | Std. Error | Std. Test Statistic | Sig. | Adj. Sig |
|---|---|---|---|---|---|
| MedinaBank-Indian Creek | -16.722 | 6.508 | -2.569 | 0.010 | 0.031 |
| MedinaBank-Golden Stream | -18.756 | 7.363 | -2.547 | 0.011 | 0.033 |
| IndianCreek-GoldenStream | 2.033 | 5.367 | 0.379 | 0.705 | 1.000 |

Asymptotic significance (2-sided tests). The significance level of 0.05

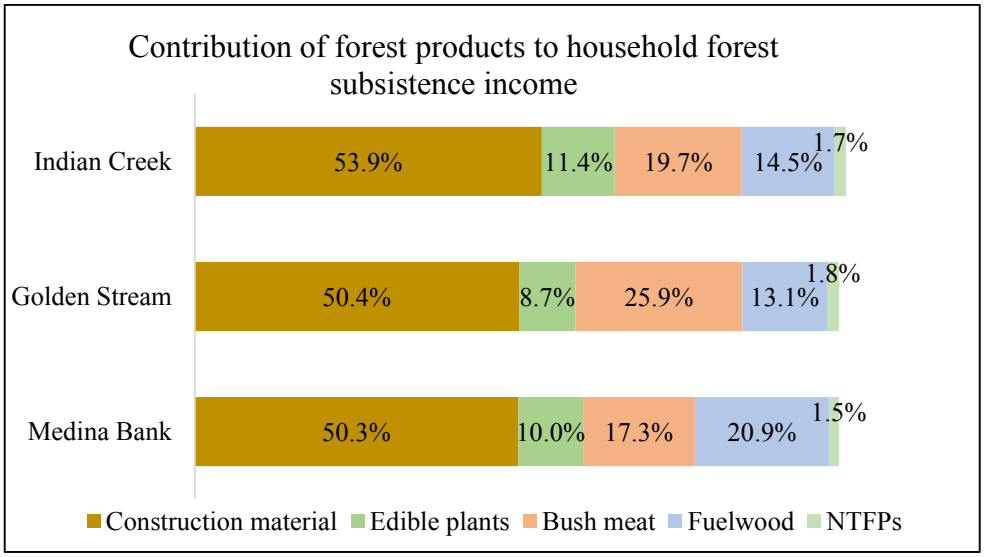



Figure 36: Percentile contribution of construction material, edible plants, bush meat, fuelwood and NTFPs to the income of households at the case study sites.

The collection of edible plant material, hunting, the gathering of fuelwood and other NTFPs constituted the remaining subsistence income of households. Although subsistence incomes of households from these forest products varied amongst the case studies (Figure 36), these were not statistically significant. The similarity can be attributed to the fact that households amongst all the case studies collected the collected, gathered and hunted the same type of forest products. Households also reported similar local market prices of these forest products. Another possible explanation is the fact that besides some households at Indian Creek, households at Golden Stream and Medina Bank did not commercialize edible plants, bush meat, fuelwood, and NTFPs.

The gross subsistence income of households from the utilization of forest products in the case studies varied slightly. Households at Medina Bank saw an average subsistence income of 1,935.62 BZD (967.81 USD), Golden Stream 2,810.41 (1,405.21 USD), and Indian Creek 2,637.09 BZD (1318.55 USD). Although the average subsistence income of households between villages varied (Figure 37), a nonparametric Kruskal-Wallis test revealed that the mean and distribution of subsistence income from the utilization of forest products amongst villages was not statistically significant (significance of 0.068 at a 95% confidence interval). This is primarily because household within the three communities collected similar amounts and types of construction material, edible plant products, game species and NTFPs.

From the three villages in this case study, only households at Indian Creek reported cash income from the sale of forest products. Households at Indian Creek earn an average of 115.83 BZD (57.92 USD) from the collection and sale of NTFPs. Given that none of the households at the

other communities earned cash income, this income was statistically significant when compared in a nonparametric Kruskal-Wallis test (Table 24).

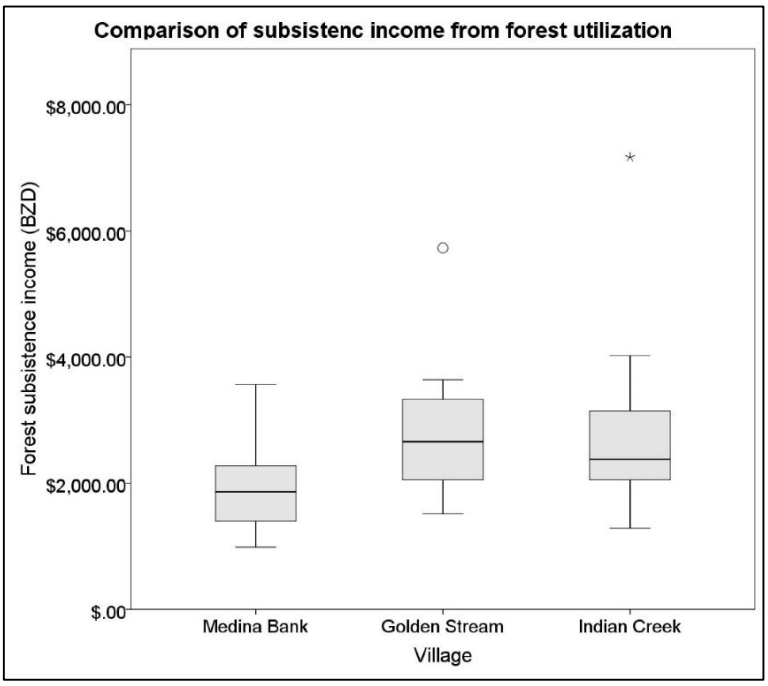



Figure 37: Subsistence income of villages from the utilization of forest products.

Table 24: Pairwise comparison of cash incomes of communities using nonparametric Kruskal-Wallis at 95% confidence interval.

| Pairwise comparisons | Test statistic | Std. Error | Std. Test Statistic | Sig. | Adj. Sig |
|---|---|---|---|---|---|
| MedinaBank-Golden Stream | 0.000 | 5.458 | 0.000 | 1.000 | 1.000 |
| MedinaBank-IndianCreek | -11.667 | 4.824 | -2.418 | 0.016 | 0.047 |
| GoldenStream-IndianCreek | -11.667 | 3.978 | -2933 | 0.003 | 0.010 |

Asymptotic significance (2-sided tests). The significance level of 0.05

### 5.2 Direct use value from tourism

The direct partnership of Ya'axché with several women's group and small businesses at Indian Creek allows household to receive direct use values from research and tourism at the GSCP. As described in the previous chapter, women's groups and farmers offer cultural experiences, tours or handmade traditional crafts. These households received an average of 2,616.67 BZD (1,308.34 USD). Although the households who were part of a women's group (7 households) earned an average of 38% of their annual household's cash income from partnerships with Ya'axché (Figure 38), the group was not representative enough to have statistical significance (P-value of 0.168 at a 95% interval in a non-parametric Kruskal-Wallis test). The cash income of the two small businesses which occasionally host visitors on behalf of Ya'axché was not made available by households. The indication is that however, at least 15% of their annual earnings depended on the management of the GSCP.

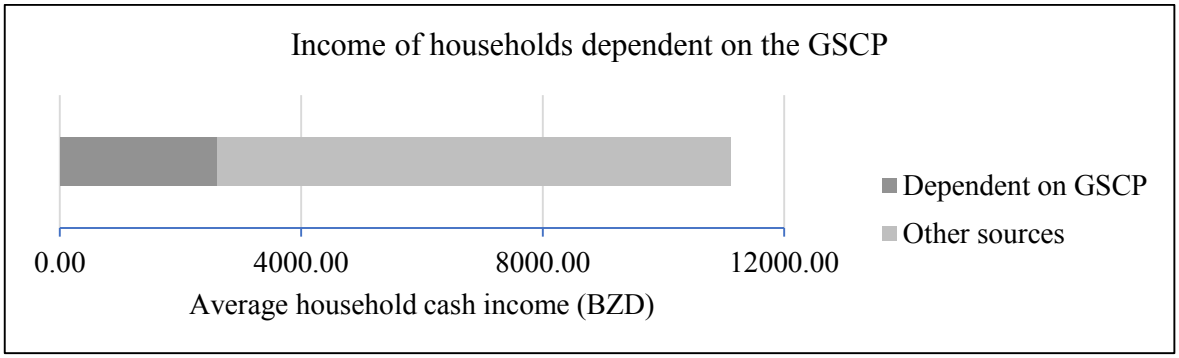
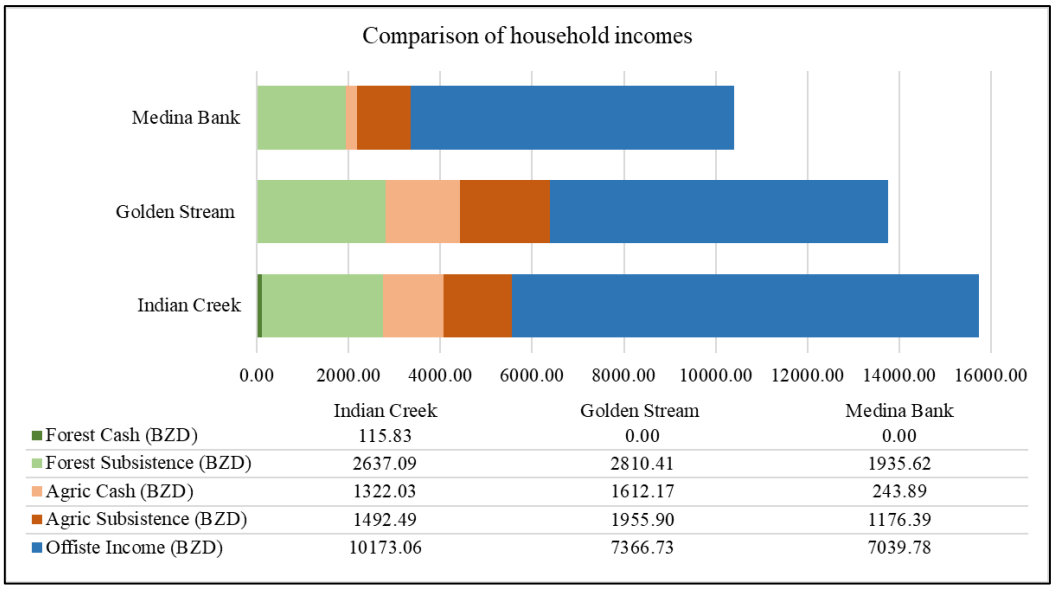



Figure 38: Average household cash income dependent on the management of the GSCP at Indian Creek.

Interestingly, only households at Indian Creek have developed lasting partnerships with Ya'axché. It can only be assumed the location of Indian Creek and recent infrastructure developments plays a role in the success of entrepreneurship ventures of households. In the past, the Indian Creek Lodge was a popular tourism destination which allowed the development of tourism related businesses in the village. Today, the recent paving of the Thomas Vincent Ramos Highway and the opening of Harvest Caye in 2016—a cruise tourism island destination—has increased tourism in southern Belize. The Nim Li Punit Archaeological Reserve which is located in the village is one of the popular attractions for cruise tourists. Additionally, training and capacity building provided by Ya'axché and the Government of Belize through the Belize Trade and Investment Development Service has facilitated the financial sustainability of these small businesses.

**5.3 Comparing direct use values from the forest to other forms of incomes**

Households in this single case study had three major sources of income: forest based, agriculture, and offsite income. In the case of agriculture and forest utilization, subsistence and cash incomes were observed. The contribution of income from the utilization of forest products to the gross income of households were relatively similar across communities; between 17.5 to 20.4 percent (Figure 39 and 40). Similarities in the contribution of forest resources to the incomes of households across the case studies can be attributed to the fact that all the households extracted the same types of forest material. Additionally, the reported market price of these forest products were also similar. The utilization of forest products was not related to any demographical characteristics of households (see Annex 7, 8 and 9 for Pearson's correlation). While correlation does not mean causation, a positive relationship between subsistence forest income and agricultural income was detected at Medina Bank and Golden Stream (Annex 7).




| | Indian Creek | Golden Stream | Medina Bank |
|---|---|---|---|
| Forest Cash (BZD) | 115.83 | 0.00 | 0.00 |
| Forest Subsistence (BZD) | 2637.09 | 2810.41 | 1935.62 |
| Agric Cash (BZD) | 1322.03 | 1612.17 | 243.89 |
| Agric Subsistence (BZD) | 1492.49 | 1955.90 | 1176.39 |
| Offiste Income (BZD) | 10173.06 | 7366.73 | 7039.78 |

Figure 39: Summary and comparison of household incomes at Medina Bank, Golden Stream, and Indian Creek.

Agricultural incomes across the case studies were similar to those obtained from the utilization of forest products (Figure 39 and 40). Agricultural income contributed between 13.6 to 25.9 percent of the household incomes across the communities. Agricultural income at Medina Bank was however lower than the other communities. A possible explanation to this can be the landlessness of households who had recently moved to Medina Bank. This deduction is made from the positive correlation that exists between subsistence agricultural income and land size, as well as number of years since the household had been living at Medina Bank (see Annex 7 for Pearson's correlation). Agricultural income, which translates to agricultural productivity was highest at Golden Stream (Figure 39 and 40). This seems to be a direct response to the need to substitute the deficit of income generated from employment or other activities.

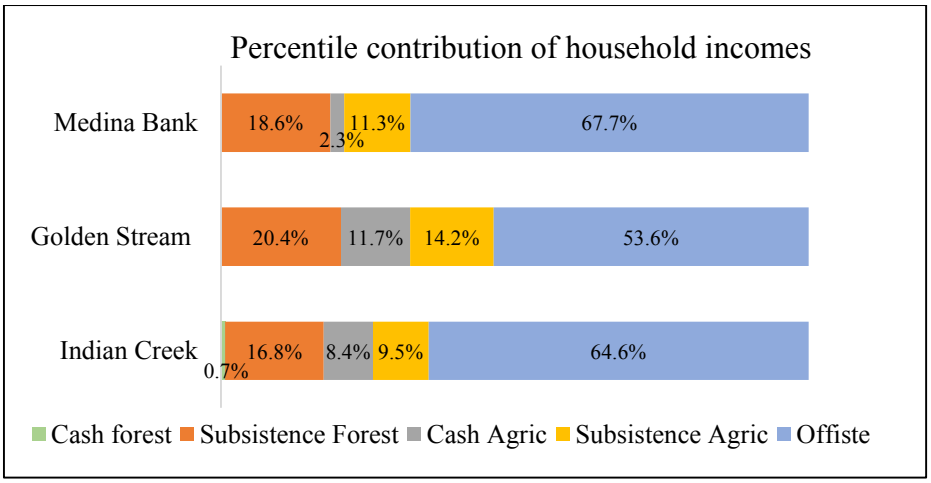



Figure 40: Comparison of percentile contribution of sources of income of households at Medina Bank, Golden Stream and Indian Creek.

Income from offsite employment and other activities contributed to more than 50% of household incomes in all the communities (Figure 39). However, offsite income of households at Indian Creek was higher than those at Golden Stream and Medina Bank. This is primarily attributed to the fact that households at Indian Creek reported income largely dependent on tourism. Additionally, several homes had small businesses dependent on tourism and had skilled jobs (see chapter 4). At Golden Stream and Medina Bank, the average income from offsite activities and employment were similar. The offsite income from these two communities depended largely on neighboring companies; salaries which were lower than those reported at Indian Creek.

When all modes of incomes are summed, Indian Creek received the highest gross income, followed by Golden Stream and finally by Medina Bank (Figure 39). Although the average household incomes from the utilization of forest, agriculture, and offsite activities and employment are different across case study communities, when compared using a nonparametric Kruskal-Wallis test at a 5% confidence interval, the differences were not statistically significant (Table 25). It is worth pointing out that the reported incomes from offsite activities and employment at all the communities were lower than the average annual incomes of Belizeans reported by the SIB in 2019 (14,928.00 BZD or 7,464 USD).

Table 25: Comparison of mean and distribution of the types of income of households across communities using non-parametric Kruskal-Wallis test.

| | n | Test statistic | d.f. | Sig. |
|---|---|---|---|---|
| Mean and distribution of cash income from agriculture across communities | 60 | 2.108 | 2 | 0.349 |
| Mean and distribution of subsistence income from agriculture across communities | 60 | 4.253 | 2 | 0.119 |
| Mean and distribution of offsite income across communities | 60 | 1.346 | 2 | 0.510 |

*Significance level of 0.05 at 95% confidence interval, d.f.: degrees of freedom, sig.:significance

### 5.4 Benefits and adoption of livelihoods promoted by Ya'axché

Fifteen forms of benefits arising from the implementation of community outreach and livelihood programs by Ya'axchéwere found across the case studies (Figure 41). Eleven of the 15 reported benefits were trainings offered to farmers, women's group members, and entrepreneurs. Most of these trainings and workshops were part of several livelihood projects executed by Ya'axché over the past 5 years. The distribution of these benefits were dissimilar between communities. At Golden Stream and Medina Bank, about the same number of households saw some form of benefits from programs implemented by Ya'axché: 55% and 53% of participating households respectively. At Indian Creek more households (61%) saw some

form of benefits from Ya'axché. The types of benefits seen at each community was also different.

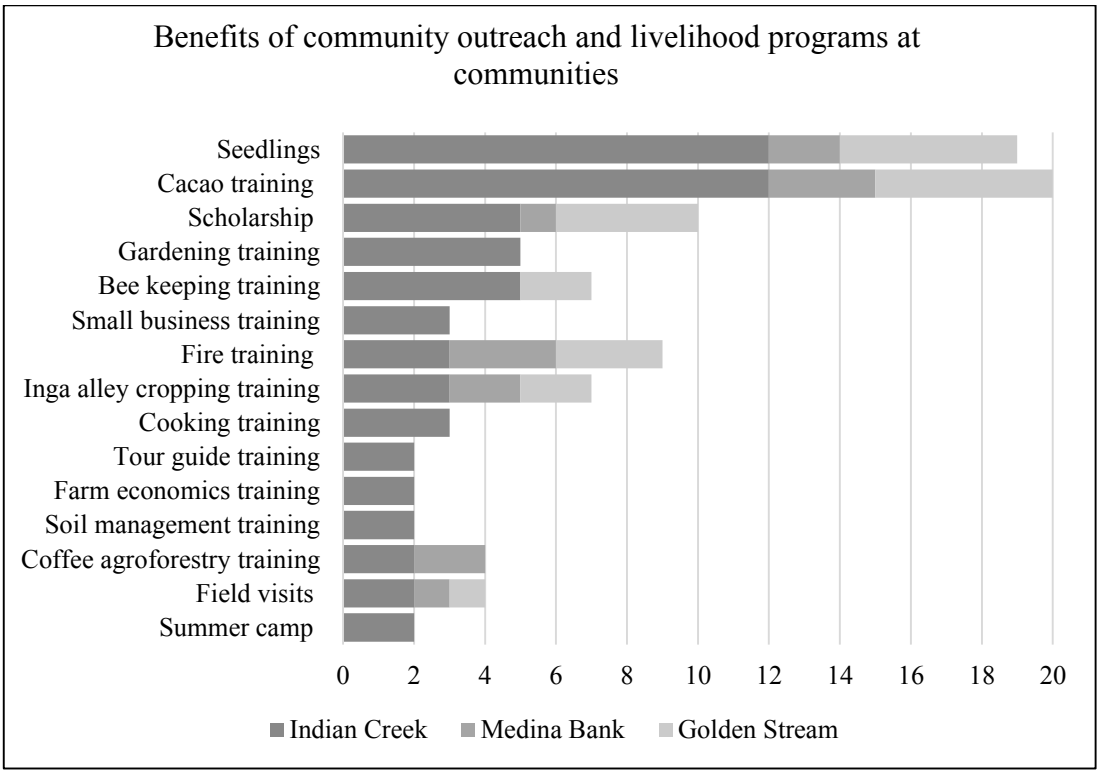



Figure 41: Benefits received by households from livelihood and community outreach programs implemented by Ya'axché.

Training in cacao agroforestry was the most common form of benefits reported by households across all the communities. Twenty households from the sample (n=60) participated in these trainings, most of whom were from Indian Creek. Seedling trees are often provided at the conclusion of these trainings. Consequently, seedling donations were the second most common benefits reported by households. From the households who participated in these trainings, at Indian creek 11 of the 12 had adopted agroforestry farming. From these, 10 households already had productive plots. At Medina Bank 2 of the 3 households adopted cacao agroforestry practices. At Golden Stream however, only 1 of the 5 households who had received training and donations related to agroforestry had adopted this practice. Coffee agroforestry trainings were also offered to households at Medina Bank and Indian Creek. All 4 households adopted coffee agroforestry.

The receipt of high school tuition and book scholarships was the second most common benefits indicated by households. This initiative is part of Ya'axché's community empowerment initiative. Five households at Indian Creek, 4 at Golden Stream, and only one household at Medina Bank reported to have received scholarships on behalf of Ya'axché. Ya'axché reports that over 167 students in the MGL have graduated from high school through this initiative.

Trainings in fire management was the third most reported benefit reported by households. An equal number of households in each community participated in these trainings. Inga alley cropping and apiculture (bee keeping) trainings were also amongst the most reported benefits obtained from Ya'axché. Training in the establishment and maintenance of inga plots were received by households at the three communities; with Indian Creek having more participation. None of the households at Golden Stream adopted inga alley cropping techniques. At Medina Bank, only one household successfully adopted and integrated subsistence farming using inga alley cropping techniques. At Indian Creek on the other hand, all 3 of the households which participated in inga alley cropping training adapted this practice. Other benefits which included summer camps for children, small business, cooking, tour guide, farm economics, and soil management trainings were only received by households at Indian Creek.

**5.5 Analysis of open-ended comments of households**

At the conclusion of the questionnaire during the direct use values interviews, households were given the opportunity provide additional comments regarding the interview, or any feedback related to the GSCP. Comments expressed by households were related to opinions, perspectives, and experiences with the management of the GSCP. A total of 150 nodes were identified and visually mapped in a text network using the InfraNodus lab (Figure 42). Nodes refers to lemmas, or subject of argument emerging from the comments of household. Nine major topical groups were identified; community, training, resource, project, tree, plot, select, extension, and cacao (Figure 42).

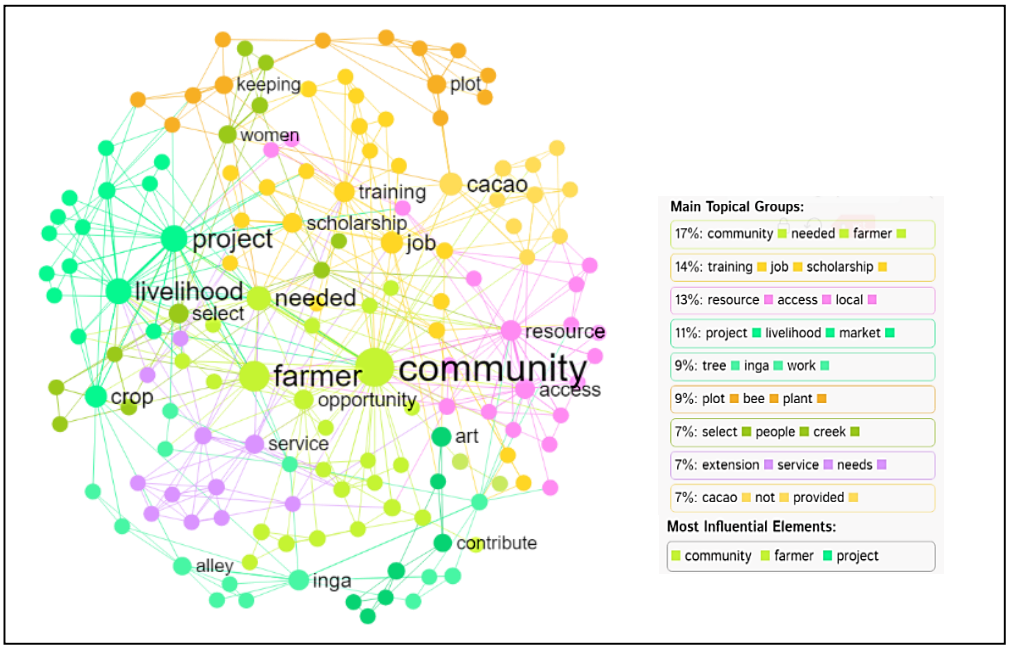



Figure 42: One node text network of comments made by households regarding opinions, perspectives, and experiences with the management of the GSCP. Each color scheme represents the network of text relating to the main topical groups (node) identified in the text.

Comments of households can be summarized with the most influential elements identified in the text network. The most influential themes were those related to community, farmers, and projects. Influential elements refer to words which have higher centrality and therefore serving as junctures for other networks.

**Community**:

Feedbacks of households related to community involvement and participation were centered around the creation of jobs and access to resources. The narratives of households at all the communities indicates that the relationship between Ya'axché was severed when it failed to deliver the jobs promised to community members. During the early years of management, community members were hired as forest rangers on a rotational basis. This however proved to be unsustainable and Ya'axché hired permanent forest rangers instead. Sour sentiments over this decision still persist today due to the shortage of employment in the area. Households felt that people who resided outside of the buffering communities were being prioritized for hiring. Moreover, they felt that too few employment opportunities were being created.

Many community members expressed their disapproval of policies related to resource access within the GSCP. Two groups of opinions prevailed regarding this; those who were not aware that resource use policies within the GSCP existed, and those who knew. Those who were unaware felt that buffering communities should be granted access to forest construction material within the GSCP. These comments were more common at Indian Creek and Golden Stream where increased travel distance for construction material was reported.

Households which were aware of the resource use policies in the GSCP felt that the permitting process was too cumbersome. According to household they would have to apply at the main office in the nearby town of Punta Gorda and would have to wait for a decision to be made. Some added that the process seems to be purposely made difficult to discourage them from accessing these construction materials. They also said that the extraction policies were too stringent and inappropriate. As one household narrates "*People from Ya'axché* [staff] *just make the rules without considering our traditions. We need about 600 to 800 cohune leaves for our homes. Their rule is that you can only take 3 to 4 leaves from one cohune tree. That means that we have to climb more than a 100 cohune trees to collect the thatch we need. That is too much work. The way my father teach me is to leave 4 leaves on the palm, and the cohune recuperates fast. Their rules are good for nature they say, but it is bad for us*". Currently, these construction material are still accessible at communal lands and forests.

**Farmers**:

Training provided by Ya'axché to farmers was the most discussed theme by respondents. Respondents felt that trainings provided by Ya'axché were adequate, but insufficient. Most of the respondents who felt that training was adequate had participated in at least one of climate smart farming strategy promoted by Ya'axché. Farmers felt that training sessions provided them with enough knowledge to adopt and operate cocoa and coffee agroforestry plots. One of the farmers who has developed agro-ecotourism around his agroforestry farm participated in farm economics and tour guide trainings provided by Ya'axché. Skills acquired during these trainings allowed him to improve interaction with visitors. Moreover, he trained his family who also operate the small business. Farmers also reported that skills obtained in apiculture were adequate and that field visits to other farmer's bee keeping ventures provided first hand insight. The urgent need for additional farming skills were also relayed by farmers. The most important being the strategy for addressing diseases related to black pod disease in cacao, low yields agroforestry plots, and fungal infections in coffee plants. Farmers who were producing cacao and coffee agreed that value added trainings—such as chocolate and roasted coffee production—could help them maximize their income from these products. Farmers who have taken up honey production conveyed that they need further training on the construction of honey boxes, hive frames and wax sheets to expand production.

The need for stable markets for farm products was also mentioned by farmers. Farmers indicated sometimes they were unable to market cacao produce because of the very unstable markets. This problem was worsened in 2020 when the global pandemic limited demands and export of cocoa beans. Households who were producing coffee indicated that a local or international market for their produce was still not available.

Farmers who had not received trainings indicated that the number of farmers selected by Ya'axché for was not sufficient. They felt that the selection of farmers seems to be biased because the same households were being chosen over and over. They also indicated that participating farmers should be selected through community consultations for transparency. These households also felt that the buffering communities were not being selected for trainings because Ya'axché has been expanding its livelihood interventions over the entire Toledo District. Negative sentiments about trainings and assistance in livelihood development projects of Ya'axché in other communities were expressed by households. As one individual recounts "*Ya'axché only comes here [the community] to ask what we need and what ideas we have and then just carry it to the other villages. we are the buffer communities of golden stream corridor; we should be helped first*". Coupled with opinions on training sessions were extension services.

Farmers indicated that extension services provided by Ya'axché were not sufficient. The extended role of Ya'axché across the Toledo District was blamed for infrequent extension services. Specifically, farmers felt that Ya'axché has shifted attention to the recently established agroforestry concession in the Maya North Forest Reserve and beekeeping in other communities.

**Livelihood Projects**:

Community involvement in livelihood project was the third most discussed theme by households. Communities felt that the development of livelihood strategies should be achieved through community consultations and involvement. They believe that this will result in more feasible approaches. Moreover, the selection of households involved with these strategies should be conducted more properly because they felt that there was favoritism over farmers at Indian Creek. Households also felt that livelihood strategies should not be treated as projects and continuous follow up and monitoring should be carried out. To exemplify, one farmer opined "*I participated in an inga alley cropping field exchange and workshop. Ya'axché gave me inga seedling. They told me how I should plant them but they never returned. I did not hear from them anymore so I just left my plot to be overtaken by the bush".*

Inga alley cropping was one livelihood strategy that had confounding feedback. Positive feedbacks were related to the corn yields. Farmers claimed that despite cultivation in the same plot of land, corn yield at inga plots were constant over the years. Another claimed that his corn yields were better at the inga plots than at his *Milpa.* Other farmers contested the feasibility of inga alley cropping. These comments were due to the fact that during the creation of an inga plot, a farmer should wait two years before cultivation between the rows is possible. Farmers also thought that inga alley cropping was too labor intensive. This was associated with the fact that constant weeding and care of the plot must be carried out without receiving any returns. Farmers would therefore find themselves having to share time between a second labor, cultivating subsistence crops and tending to the inga plot.

Members of women's group indicated that insights into hospitality, proper pricing of products, financial management and book keeping has improved their small enterprises. Accountability in these groups has improved the relationship amongst membership. As households report, some years ago the relationships among members was contentious due to a lack of financial accounting. With the adoption of proper accounting they have now managed to establish a contingency budget which they intend to use when tourism returns to Belize—post pandemic normalcy.

Other households felt that livelihood strategies targeting landless households should be initiated. Projects such as pig rearing could help households who do not have farming lands, especially at Indian Creek where there seems to be a shortage of communal lands.

Also related to livelihood projects are the high school scholarships provided by Ya'axché. Households expressed that the scholarship opportunities provided were too few. Households were grateful for tuition scholarships. However, they felt that assistance through the book scholarship program was insufficient because tuition fees were significantly higher.

# CHAPTER SIX

## 6. Implications of findings for management

### 6.1 Direct use values of the GSCP and communal forests

By exploring valuation techniques through the lens of the co-evolution model, this research provided insight into the importance of regarding protected areas as complex social-ecological systems. In this case study, focus was drawn to the Golden Stream Corridor Preserve; a private protected area. One of the primary objectives of this research was to determine the direct use values of the GSCP. The reality on the ground in this single case (embedded) study is that the direct use values from the ecosystem use of communities cannot be attributed solely to the GSCP. Direct use values originating from the GSCP were those associated with tourism and employment only. On the other hand, direct use values from the utilization of forest products and non-consumptive use of natural resources were attributed to communal forests and lands. Although the management of these two land use systems differ, these findings exemplify the reciprocity, as well as the duality that exists between protected areas and surrounding lands.

Attention is first drawn to the direct use values associated with the GSCP. The designation of protected areas to communities near them means the creation of jobs and economic opportunities to compensate for the foregone utility of ecosystem goods and services (Serenari et al., 2017). Substantive employment of local community members at protected areas is rare (Bennett et al., 2012; Hora, 2018; Nepal, 2002; Serenari et al., 2017). Hora (2018) for example found that the Pumalín Park—a private protected area—in Chile was not important for creating direct employment. Hora adds that this was due to the fact that more than 25% of the buffering population was employed by the state. Indirect economic opportunities related to tourism in protected areas more common (Bennett et al., 2012; Butler & Boyd, 2000). Nepal (2002) for instance reports that between 60% to 80% of local communities are employed from the visitation of Sagamartha National Park (Mt. Everest). In this case study, the creation of direct use values was similar; employment at the GSCP was marginal (2 households) and economic opportunities related to tourism were more common (9 households). To these 11 households, this represented between 15% to 100% of the annual cash income. The distribution of direct use values across the three communities was however disproportionate. Cash incomes related to tourism were exclusively found at Indian Creek, and those from direct employment were only detected at Golden Stream. Cash incomes associated with tourism seems to be localized phenomenon, and not a direct result of the establishment of the GSCP. According to households, opportunities for tourism based businesses initiated with the establishment of the Belize Lodge and Excursions in the village in 1998. This lodge has been closed since 2012, but

the Nim Li Punit Archaeological Reserve remains an important visitation site for cruise tourism in Southern Belize. Ya'axché has nevertheless played an important role in enhancing the capacity of tourism based enterprises through trainings (see chapter 4 and 5). According to Ferraro and Hanauer (2014), incomes associated with tourism in protected areas is dependent on the ability of households to capitalize on localized tourism. This means that the ability of individuals to capitalize on these opportunities also depends on their disposable income. Indian Creek had higher average annual household incomes, and was also the only community who had capitalized on tourism opportunities at and around the GSCP.

The second point of importance is the absence of direct use values from consumptive and non-consumptive utilization of resources from the GSCP. All forest based construction material, edible forest products, bush meat, fuel wood, and other forms of NTFPs were obtained from communal forests and lands. At first glance, this may seem as a reflection of the autonomous governance of private protected areas. General knowledge has it that private protected areas restrict communities from accessing resources, and are more effective in doing so (Clements et al., 2016; Hora et al., 2018). The management of the GSCP has been quite the opposite. Despite being a private protected area, Ya'axché has expressed its willingness to grant communities access to construction material given reasonable demands. While some community members expressed that they were not aware that construction material could be harvested from the GSCP, and others displeased with the resource extraction policy; the urgency to access resources within the GSCP does not seem to be a present reality. This conclusion is drawn from the low rates of illegal incursions in the GSCP reported by Ya'axché. When compared to the other protected areas managed by Ya'axché, in 2018 only 14% of all detected illegal activities occurred in the GSCP (Ya'axché Conservation Trust, 2018). Similarly, in 2019 only 12% of reported illegal activities originated in the GSCP (Ya'axché Conservation Trust, 2019a). This result epitomizes the importance of recognizing and integrating surrounding lands into the management of protected areas.

The contribution of the management communal of land and forest at the buffering communities to the integrity of the GSCP ought to be recognized. The contribution of customary laws and land tenure to conservation and the reduction of deforestation has been widely recognized (Chi et al., 2013; Epule et al., 2014). In the Muluy community in East Kalimantan Indonesia for example, customary shifting agriculture was consistent with low rates of deforestation (Nugroho et al., 2018). At a deforestation rate of 0.05 hectares per capita/year in Muyu, more than 50% of agricultural land under alternating vegetation (farming and fallow land) was kept between 1 to 3 km of the settlement for a period of more than 20 years (ibid). Although not

comprehensively measured in this research, it can be argued that communal land and forest use rules at the three case studies permit the prevalence and availability of forest products necessary for the subsistence lifestyle of households. Under traditional *Milpa*, households had at least 38% of their lands under forested conditions. Yet, other demographical characteristics such as population density have been recognized to play a role on the integrity of protected areas (Tritsch & Le Tourneau, 2016). Pfeffer et al. (2005) for instance found a positive relationship between population growth and land allocated to agriculture in the Cerro Azul Meambar National Park in Honduras—managed under a biosphere approach. The overall consequence of this trend was a decrease in fallow periods of traditional farming; increase in permanent crops; and increased pressure on conservation area for access resources and agricultural expansion. Case studies in this research were characterized by low population densities. However, Mayan communities are experiencing rapid population growth due to rural to rural migration within Belize, as well as immigration from Guatemala—availability of land being the main reason (Binford, 2007). The ability of communal forest and lands to supply forest products for the subsistence livelihood of households may therefore be compromised in the future.

The direct use values of communal forest were found to be mainly for subsistence purposes. Construction material was the most important forest product in this case study. Besides contributing to more than 50% of a household's forest subsistence income, all the 60 participating households utilized forest based construction materials. It must be pointed out that the gathering of construction material occurs every 7 to 10 years. The contribution of construction material is therefore periodical and not annual. The embeddedness of forest material for the construction homes in the Mayan culture seems the explain the importance and similarities in use of these materials across the communities. Many of the participating households had 'modern' homes made of cinder block walls and the roofs were constructed from bush sticks and thatch. Others had one building made of entirely modern material and a second made with traditional forest material. Although an alternative explanation could be the lack of cheap substitutes for forest based construction material. Although no correlation was detected between incomes from employment and the utilization of construction forest material (Annex 7,8 and 9), traditional Mayan homes were more common at Medina Bank and Golden Stream where incomes from employment were lower.

Comparing the contribution of construction material to a household's forest based income to other regions is difficult due to context specificity. Langat et al. (2016) for example reports that in East Mau Forest in Kenya, construction material constituted only 18% of a household's forest subsistence income. In Latin America, the average incomes of households from construction

material was reported to be around 25% (Angelsen et al., 2014). These differences in reported values are primarily due to the absence of a perfect market system for the valuation of environmental goods and services (Jost & Ingo, 2014). The subsistence incomes from forest based construction material reported in this case study were related to the local market prices recounted by households.

Forests in rural settings play an important role in improving dietary diversification, nutrition and food security (Friant et al., 2019; Rasolofoson et al., 2018). Hunting for bush meat and gathering wild vegetables is often carried out as an effort to complement shortages of food produced from small scale agriculture (Abere et al., 2016; Friant et al., 2015). In this case study, the provision of food was the second most important role of communal forests. About one thirds of a household's subsistence income from the forest came from hunting and gathering of edible plant materials. This percentile contribution was less than the 53% of forest food based income reported for Latin America; but were more consistent with those in Asia and Africa; 27.2 and 24.2 percent respectively (Angelsen et al., 2014; Langat et al., 2016). Results indicated that households saw more subsistence income from the hunting of bush meat. However, this is merely a reflection of the higher market price for bush meat. Plants utilized for food were more important because they were gathered more frequently and more household engaged in this activity than hunting.

Also related to forest subsistence is the supply of fuelwood. Plant biomass was the main source of cooking fuel in all the communities. Only a handful of households reported to use liquid petroleum gas for cooking once in a while. Although liquid petroleum gas was readily accessible, its high price has been the main reason why households still use firewood. Angelsen et al. (2014) report that that globally, fuelwood consumption represents about 31.2% of a household's forest based income. In Latin America however, fuelwood accounts to for only 11.7% (ibid). The fuelwood consumption of household in this study (between13% to 21% of a household's forest based subsistence income) were consistent with these reported values. The collection of fuelwood by poor households in rural areas is often associated with forest degradation (Cooke et al., 2008; Démurger & Fournier, 2011). Households in this case study however admitted that they rarely cut down trees for fuelwood purposes; primarily because deadwood is available at farm lands.

The subsistence use and commercialization of other NTFPs in rural communities has been reported globally (Ali et al., 2020; Angelsen et al., 2014; Aung, 2012; Kimengsi et al., 2019; Langat et al., 2016). The utilization of NTFPs played a minor role in the incomes of households (less than 2% of forest based cash and subsistence income). This may however be an under

reporting phenomenon. Although a vast majority of households admitted to using wild plants for medicinal purposes, the details of their traditional medicinal plant uses were not shared. Medicinal plants were treated with much care because households had the view that sharing their medicinal plant knowledge would lead to their commercialization—of which they would gain no benefit. Moreover, the collection and administration of medicinal plants was left to the spiritual leaders, so households were unable to recall names of plants and the quantities utilized. Only households at Indian Creek, and one at Golden Stream reported cash income generation from NTFPs. Forest products exploited for cash income generation were directly related to tourism within and outside of the community. The minor role of communal forests in the generation of cash income can be explained by two realities. Firstly, the commercialization of timber products is regulated by customary rules. Secondly, although households recognized that sometimes community members sold some forest products such as bush meat; the local demand for NTFPs is not large enough to create an organized marked for the commercialization and trade of these products. This is coupled with the fact that a vast majority of the surrounding communities still have sufficient forests cover meet their demands for forest products.

Rural communities also rely on small scale agriculture for the production of staple foods (Abere et al., 2016; Friant et al., 2015). For comparison reason, agricultural outputs of households were measured. Small scale *Milpa* farming, backyard gardening and the rearing of local varieties of livestock contributed not more than a quarter of the household's gross income; of which at least half was used for subsistence purposes. The sale of surplus agricultural produce only contributed minimally to the overall household income. This is primarily because extensive cultivation of marketable vegetables has never been part of the livelihood of the Mayan communities. Moreover, modern practices such as the use of pesticides is rare; probably due to the lack of financial resources. The lack of all-weather roads and running water at farms were identified as the main barriers for agricultural productivity. At some households, these factors were also blamed for the failure of agroforestry plots. Interestingly however, several households at Indian Creek had ventured into apiculture and agroforestry. Although not reflected in the community average due to small sample size, households who had adopted these practices reported higher cash incomes from agricultural produce than those who did not. As tempting as it may be to conclude that the adoption of livelihoods promoted by Ya'axché contributes positively to households' livelihood security, cash income cannot be used as a sole proxy. The diversification of agricultural produce at farms has created complementarity between incomes at these households, but livelihood security remains low due to shared risk (Ellis, 1998). Natural phenomenon associated with climate change (such as hurricanes and drought poses high risk to

farming households. Therefore, other livelihood aspects such as income increasing capabilities, the role of gender, motivations, risks, patterns of livelihood, and multiple streams of incomes need to be considered before making that assertion.

Despite being very traditional Mayan communities, cash income from employment and other income generating activities are the major contributors of a household's income in all the communities. The dependence of households on offsite wages is often related to seasonal shortages and risks of production at owned farms (Ellis, 1998). Byron and Arnold (1999) add that marginal returns from labor intensive forest activities pressures households to seek higher income wages from employment. In this case study, the production of staple food and availability of edible forest products was seasonal. Agricultural produce for subsistence was also not enough as households reported purchasing staple food from other communities. The importance of cash income also forces them to market some of their staple food. Cash income from the sale of forest products was also absent. Although employment opportunities were readily available in the vicinity, they were seasonal and wages earned were also marginal. Employment and other offsite income generating activities such as the sale of handicrafts was also possible due to their convenient location along the main Highway. Employment opportunities in the nearby towns were readily accessible. The variation of cash incomes from employment and income generating activities were directly related to the type of employment and salaries received. Generally, employment related to tourism earned more cash income for households. Offsite wages remain and will become increasingly important as households have embraced secondary and university education, and electricity will soon be installed in the communities.

### 6.2 Benefits and livelihoods promoted by Ya'axche: strengths and weaknesses

To counteract the foregone economic opportunities related to protected area establishment, management and governance focuses a lot on the development of alternative livelihoods; creation of economic opportunities; community improvement; and knowledge creation (Deni et al., 2019; Katikiro, 2016; Roe et al., 2015). Management of the GSCP was not an exception to this reality. The enumeration of benefits originating from the management the GSCP reflected that more than 73% of community work executed by Ya'axché was related to the development and improvement of livelihoods. At most, about one third of the sampled household (n=60) were impacted by this program. Although these households were satisfied with the outcomes of livelihood related projects, those who did not perceive any tangible benefit had negative opinions related to this. As Serenari et al. (2017) argues, the intangible benefits and the failure of the market system to capture the value arising from the development of skills

results in contentious support for protected areas management. Although the climate smart farming initiative has brought benefits and development to some of the communities; some of the weakness associated with these projects ought to be recognized.

Firstly, the concentration of Ya'axché on forest integrity of the landscape seems to be pushing homes from their subsistence farming practices. Farmers who had adopted agroforestry and apiculture at Indian Creek reported higher cash agricultural incomes than those associated with subsistence use (see Chapter 6). In other words, farmers were producing cash crops and not subsistence crops. There is no doubt that marginal returns from labor and investment in cacao and apiculture are higher than those from subsistence crops. However, these households use family labor at their farms. The shift towards cash crops therefore seems to be directly related to this, as diversification in farming practices increased workload which reduces overall productivity (Colnago et al., 2015; Feder, 1985). As one farmer points out: "*we really need help with our cacao plots because when it's pruning season we cannot do all the work at our plantation* [plantation is used interchangeable with *Milpa*]. *I don't have money to pay for worker, sometimes I even abandon pruning to do other things around the farm. Maybe if ya'axché can provide some assistance with workers it will improve my production*". Other factors such as livelihood security, risks, and seasonality need to be considered (Ellis, 1998). Already, in 2020 several farmers reported that they were been unable to market their cacao produce due to the pandemic.

Secondly, inga alley cropping is being met with resistance by community members. Inga alley cropping is being promoted by Ya'axché as an alternative to traditional slash and burn in *Milpa* farming. Inga alley cropping does not only address the damaging impacts fires have on soils, but also reduces the incidence of escaped agricultural burns–a serious threat to the GSCP. Based on reports of farmers, inga alley cropping in the MGL follows the Guama Model. This model incorporates 5000 inga trees per hectare at a spacing of 4 meters. The Guana Model has been successfully adopted by more than 300 families in northern Honduras (Hands, 2021). Adoption in Honduras is motivated by the reclaiming of degraded agricultural lands along steep slopes. At the case study communities, farmers do not seem to fully grasp the benefits of adopting this farming strategy as many have large farming lands and crop productivity at *Milpas* has been steady. According to Kongsager (2017) reluctance of Mayan farmers in Toledo to adapt inga alley cropping is their fear of negative results on their corn production. This uncertainty is combined with a myriad of other barriers; amongst the most common being *Milpa* culture; treatment of livelihood interventions merely as project cycles; interests of farmers and the wider community; low availability of capitals for investment; inconsistent availability of technical

knowledge (from extension services); availability of family labor; traditional land tenure; inaccessible markets for marketable crops; and trust between communities and outside institutions (ibid). Narratives from farming households were similar to the aforementioned barriers identified by Kongsager in three Mayan villages (Crique Sarcyo, San Jose and Jalacte). A salient acknowledgement however is the fact that shifting slash and burn to inga alley cropping poses risks of losing and changing traditional ecological knowledge associated with *Milpa* farming. Care must therefore be taken when promoting inga alley cropping, and removing barriers to its adoption.

Failure in the adoption of other climate smart farming promoted by Ya'axché seems to be associated with household capitals. All the household who had adopted some form of livelihood promoted by Ya'axché had leased titles to their lands and multiple sources of income. Moreover, from observation the households seemed to have better assets such as completely modern homes, vehicles and solar panels amongst others. According to Bennett et al. (2012) the promotion of alternative livelihoods at communities buffering protected areas should be undertaken by using capital based/asset based approaches. These capitals include those related to a household's available financial, physical, social, human and natural capital (Ellis, 2000). However, capital based approaches fail to recognize the role of tradition and cultural values associated with livelihood adoption (Daskon & Binns, 2010). For example, an assessment of household perspectives on agroforestry at Golden Stream by Pontara (2019) synthesizes that cultural values and traditions influenced perceived benefits and risks of adopting agroforestry. His finding indicated that some farmers could not perceive farming to be something different from what their grandfathers has taught them.

The remaining community interventions can be described as community development and empowerment initiatives. Perhaps the most representative example of this are the partnerships engaging women's groups. By contributing to the household' income, women engaged by Ya'axché are able step out of their husband's shadow. However, extensive dependence on tourism as the single wage earning activity may not be sustainable (Serenari et al., 2017). Tis is associated with the seasonality and uncertainty surrounding tourism. For example, households who depended on women's group activities for income reported that they had not earned income for at least 3 months due the tourism restrictions related to the Covid-19 pandemic. One of the women's group had even dismantled their gift shop. Ya'axché has also been able to promote community development by making scholarships available to the youth. The promotion of higher education is important as it reduces forest dependency (Ali et al., 2020). Other reported benefits such as summer camps hold promising results for changing

attitudes and perceptions of the youth. Studies have shown that negative attitudes about protected areas can be eventually replaced by advocacy through the dissemination of information about the positive contribution of protected areas to livelihoods, especially direct economic incomes (Hayes et al., 2015; Liu et al., 2010).

These findings do not serve as grounds to contend that livelihood strategies are inadequate and should be completely excluded, but rather that Ya'axhé should undertake livelihood initiatives as a long term effort accompanied by extensive community involvement, consultation and monitoring to allow adoption and transition of farmers. Canela and Weiant (2004) for example argue that for alternative livelihood and community development project to be effective, high community involvement and participation is needed; the approach should involve a combination of scientific and traditional knowledge; gradual enhancement of local perceptions is a must; viable economic incentives should be provided by the alternative; and monitoring and evaluation should be carried out even after project implementation.

### 6.3 Insights into the SES of the GSCP and buffering communities

Perspectives in human and ecological dependence through the social ecological coevolution is a useful model for building resilient and sustainable SESs (Desjardins, 2019). By integrating the valuation of the direct use values of the GSCP into the coevolution model, insight in the SES of the case study can be drawn. SES thinking in protected areas draws attention on the equal importance of spatial and temporal scales of territories within a protected area and those surrounding it (Hansen & DeFries, 2007; Mathevet et al., 2016). Within the setting of this case study, the ecological and social occurrences within the GSCP and communal lands and forests cannot be separated. Direct use values related to the GSCP were limited, but other ecological processes not enumerated in this study remains important. Functions such as head water protection by the GSCP are vital for the Golden Stream, and Indian Creek who utilize the Golden Stream River. Other important roles such as the movement of metapopulations between the GSCP and surrounding communal lands, especially game species are also vital functions. The Deep River Forest Reserve also plays an important role in the ecological context of Medina Bank. Communal forests on the other hand serve as buffers for of edge effects and corridors between the GSCP and other protected area.

Feedback loops that existing between managers, the natural environment and the social systems are captured in the management interface (Cumming et al., 2015; Cumming & Allen, 2017; Pretzsch et al., 2014). In this case study, customary rules at the communities buffering the GSCP governed forest utilization and farming techniques. Perhaps one of the most important being the zero tolerance of sale of communal lands under the *Alcalde* system. The continued

dependence of communities on communal forests and lands for forest resources epitomizes the contribution of customary laws to the integrity of the GSCP. Because forest resources are available in communal lands, minimal pressure is exerted on resources within the boundary of the GSCP. These communities also hold legal land tenure to their land since 2009, but are characterized by a lack of comprehensive sustainable forest management plan (Santos, 2009). Communal lands and forest are therefore in peril of degradation with the emergence of new market opportunities such as cattle ranching, and population growth. This was already visible at Indian creek where large areas have been cleared for cattle ranching. A shortage of communal lands and an increase travel distance for the collection of construction material was reported at Golden Stream and Indian Creek.

The second unit in the management interface are the strategies undertaken by Ya'axché to "maintain a healthy environment with empowered communities by fostering sustainable livelihoods". From the 8 management programs implemented by Ya'axché, education and advocacy, climate smart farming, capacity building, and ecotourism have higher impacts on the social counterparts as these were detected in the benefits and comment section of the household survey (see Chapter 5). Themes associated with the management of the GSCP (Chapter 5, can be linked to Lockwood's (2010) principles of good governance: legitimacy, transparency, accountability, inclusiveness, fairness, connectivity, and resilience. Feedback on these points were ambivalent: household who saw tangible benefits from sustainable livelihood projects had positive feedbacks, with suggestions on how to improve them. Households who did not see any benefits felt excluded and consequently had negative comments about the overall management. The consensus in three communities was that livelihood impacts were minimal due to the expanding jurisdiction of Ya'axché over the years (the co-management of other protected areas besides the GSCP). These outcomes reflect one of the main dilemma in private protected areas management; the autonomy they exercise over their property does not afford accountably on outcomes of management implantation (Serenari et al., 2017). Collective action in conservation can only be achieved if community members and stakeholders of diverse roles, ideas and feel that they play a mutual role in solving and adopting sustainable strategies that are beneficial to both (Barnaud & Antona, 2014).

# CHAPTER SEVEN

## 7. Conclusions, limitations and outlook

By using the coevolution model to guide direct use valuation of the GSCP, insight into the social ecological system of the GSCP and buffering communities has been drawn. Results of this case study has revealed that direct use values of the GSCP are only associated with tourism and employment. The distribution of these direct use value was disproportionate; only two households in Golden Stream and a handful at Indian Creek saw direct use values from the GSCP. Direct use values associated with the utilization of forest products was determined to be obtained from communal forest and lands. Reported as cash and subsistence income in this case study, construction material was the most important direct use value received from communal forest, followed by materials for food, then by fuel wood and finally NTFPs. In all case study sites, direct use values from communal forests were not statistically significant.

For comparison purposes, subsistence and cash incomes from agriculture, and cash income from employment and other activities were also enumerated. Both forest based income and agriculture (subsistence and cash) contributed to the lower half of a household's gross income. In all the case study sites, cash income from employment and other income generating activities played a more important role in the gross incomes of all households. The gross incomes of households were greater at Indian Creek, followed by Golden Stream and lastly by Medina Bank.

Benefits arising from the management of the GSCP by Ya'axché were seen at all the caste study communities. These benefits came as part of Ya'axché's education and advocacy, climate smart farming, capacity building, and ecotourism programs. Training in climate smart farming were the most common benefits households received in all the communities, this was accompanied by the provision of seedlings for the adoption of these farming practices. Youth in the communities were also recipients of high school scholarships. The distribution of these benefits across the communities were similar. Notwithstanding, trainings and capacity building related to tourism were only reported at Indian Creek.

Households at Indian Creek had higher rates of climate smart farming adoption; amongst the most common being cacao agroforestry, bee keeping, and inga alley cropping. Failure of households to adopt climate smart farming strategies does not seem to be a lack of inclusion on behalf of Ya'axché, but rather by the manifestation of barriers. Barriers seemed to be related to the availability of cash income; availability of family labor; land tenure; and cultural inappropriateness (in the case of inga alley cropping).

In the context of SES, the relationships between biophysical, management and social interface were evident. Firstly, the GSCP is an important source of many ecological processes not accounted for in this study. Secondly, the integrity of communal forests promoted by customary forest and land use contributes positively to the GSCP by completely eliminating the demand for forest resources within the GSCP. Subsistence agriculture and accessible offsite employment also contributes to alleviating forest dependency. These localized livelihoods, coupled with the execution of compliance, education, research and monitoring, climate smart farming, capacity building, advocacy, land use monitoring, and ecotourism programs by Ya'axché have guaranteed the resilience of not only the GSCP and communal lands and forests, but also the MGL. Nevertheless, several weaknesses associated with legitimacy, transparency, accountability, inclusiveness, fairness, connectivity, and resilience were narrated by community members.

**Limitation**

Limitations in this case study are associated its external validity and reliability. External validity is the extent at which the findings of the research can be used for generalizations, and reliability refers to the replicability of a research (Adolphus, 2021; Booth et al., 2016; Yin, 2009).

This study used market valuation to determine the direct use values of the GSCP, and by extension those of communal forests. The first critique against this approach is the fact that there are no perfect markets where demand and supply reflects the proper market price of an ecosystem good or service (Jost & Ingo, 2014). For example, vines used in the thatching of homes had no market value, but was complemented by interviewee's choice or willingness to pay for one roll of vine. Using own-reported values however reflects local demand and supply conditions because it represents the real price of goods and services given a choice (opportunity cost) (Luckert & Campbell, 2012). Secondly, the market approach fails to account for the non-use values of goods and services (Costanza et al., 2017; Jost & Ingo, 2014), therefore resulting in an undervaluation of the GSCP. Yet, these are more difficult to ascertain due to their intangible nature. Notwithstanding, these pitfalls can be addressed by conducting a comprehensive TEV.

The reliability and validity of data used for this research was largely impacted by the outbreak of the SARS-CoV-2 (Covid-19) in Belize. The initial objective of this research was to conduct a management effectiveness evaluation along with a direct use valuation. This was impeded due to increasing restrictions related to Covid-19 and the data presented here are only those which were collected before the country went into a full lockdown.

Building trust between the interviewee and interviewer is an essential element for guaranteeing reliability (Djamba & Neuman, 2002; Yin, 2009). Building trust during a pandemic was almost impossible. Household in the case study communities were suspicious of outsiders and several refused to participate in the household interviews. This resulted in socially desired responses and acquiesce. The first response bias is related to the construction of socially desirable responses by interviewees. Entry into the GSCP and the Deep River Forest Reserve is prohibited and is punishable by law. Households who had actually accessed resources from these protected areas therefore did not report them due to fear of legal repercussions. This could be addressed in the future by spending more time with households and in the community to gain the trust of the local population.

Response biases related to acquiesce were related to the researcher's inexperience. For example, households at Indian Creek who had agro tourism businesses resisted reporting their income dependent on partnerships with Ya'axché. This could be resolved by rephrasing questions related to incomes; for example, by asking the frequency at which they offer tours to groups hosted by Ya'axhé, and what is the per person rate for tours. These data can later be used to make estimations.

Distortions of data related to sampling bias ought to be recognized. There are questions regarding the comparability of data amongst the case studies due to the nonrandom sampling approach at Indian Creek. Firstly, it must be reiterated that all case study communities were indigenous communities who exercise their right to self-determination as per the United Nations (2007). Given their right to self-governance, research protocol had to be changed so that data can be collected. Data gathered at Indian Creek was not transformed using statistical methods due to non-variance from the other case study communities. This could be addressed in the future by undertaking a non-statistical approach such as the grouping of households based on wealth, stakeholder group or other qualitative sampling approach.

**Outlook**

Results from the three case study communities has provided grounds for the suggestion of three potential management interventions to guarantee the sustainability and resilience of the SES of the GSCP and buffering communities (Figure 43). Despite depending on offsite activities for most of their income (cash), households in all communities depended on communal forests for subsistence purposes. Communities' land tenure has been affirmed by local and international courts since 2009, but they still lack appropriate management plans for their land and forests. In order to guarantee the adaptability and resilience of the SES at the study sites, it is important for Ya'axché to participate in development of a communal forest management plan. The

territories of these communities is currently being demarcated under a joint effort between the Maya Leaders Alliance (MLA), the Toledo *Alcaldes* Association (TAA), and the Government of Belize. After working with the communities for more than 20 years, Ya'axché should undertake a joint effort with all pertinent stakeholders (including the MLA and TAA) to develop a communal forest management plan at the three communities in this case study. It is very likely that a forest inventory will need to be carried out to determine the current state of communal forests. Course of action such as zonation, extraction rules based on traditional ecological knowledge, policies, short term and long term plans should be guided by the outcomes of participatory efforts.

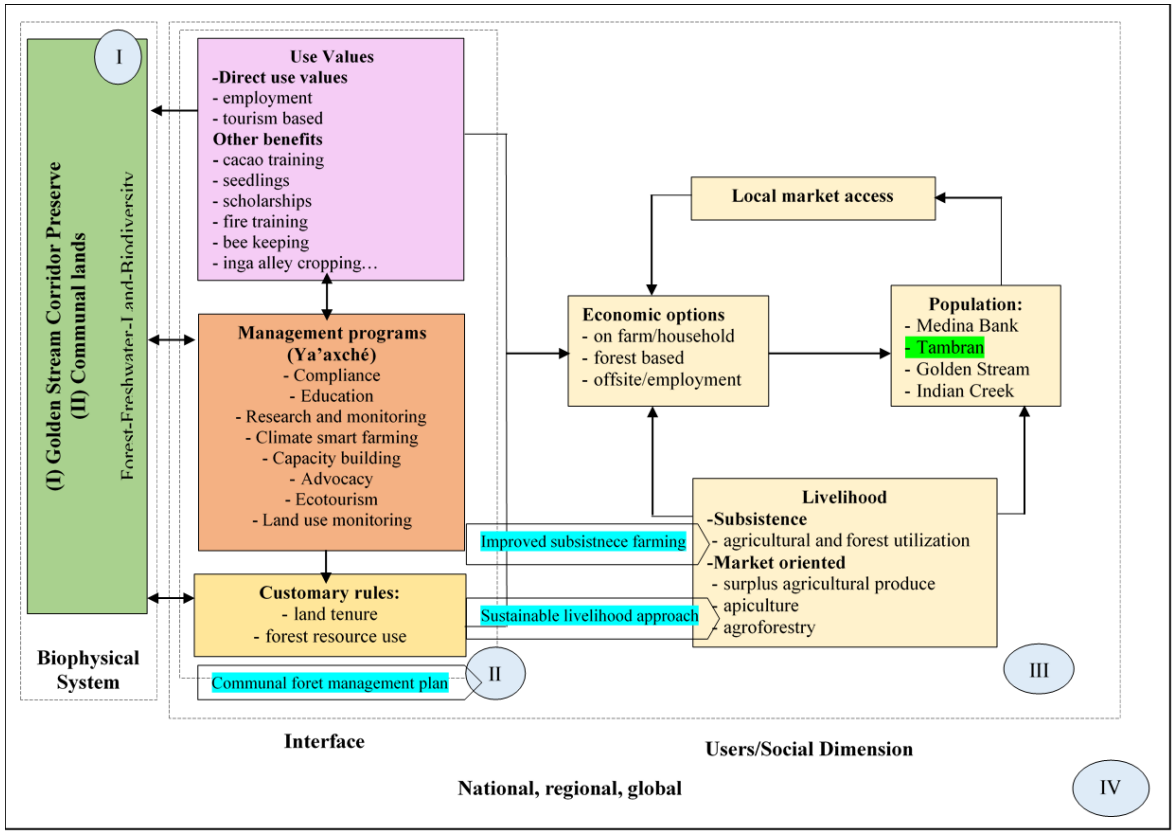



Figure 43: Adapted co-evolutionary model of the GSCP, communal forests and communities buffering the GSCP.

Existing subsistence farming offer potentials for the improvement of livelihoods of households. Earnings from the sale of surplus agricultural produce does not contribute sufficiently to household incomes. As indicated by households, yields from their *Milpas*, backyard gardens and livestock rearing is rarely enough to meet their household needs. Focus should therefore be put in improving the yields of current crops—such as beans—, as well as fostering the cultivation of new marketable crops (besides cacao, coffee and apiculture) to guarantee food security of households. This should be couples with addressing the barriers identified by households i.e. the opening of all-weather roads and the supply of water during the dry season.

Although the opening of roads is associated with deforestation and forest degradation, Chicas et al. (2016) found that is not the case for the Toledo District.

Lastly, the failure of households to adopt livelihoods promoted by Ya'axché is likely associated with their available human, natural, financial, physical, and social capital. Ya'axché should therefore undertake the sustainable livelihood approach to understand enabling aspects and barriers to the adoption of the livelihood. This should be followed by removing the barriers and creating an environment so that poorer households are provided equal opportunities for diversifying their livelihoods.

With all the limitations identified in the methodology and theoretical underpinnings of this research, the following areas can be further explored.

**Valuation of other use values of the GSCP and communal forests**: Results reflected in the study are an under representation of the TEV of the GSCP and communal forest. Exploring and determining these values remains important for understanding their contribution to Belize.

**Traditional Ecological Knowledge in the co-evolution of communal forest use**: Communities in this case study have depended on communal forest for at least 30 years. Understanding the relationship between customary rules (traditional ecological knowledge) and the sustainability and resilience of resource use in these communities could help guide the creation of community forest management plan.

**Economic model of households**: This study did not account for labor, capital inputs, value addition and rent related to subsistence farming, agroforestry, and the collection of forest resources. Further research into the economic model of households can help provide more accurate income calculations and returns related to subsistence farming, agroforestry, and forest utilization.

**Sustainable livelihood approach (SLA) model and adoption of alternative livelihood:** The adoption of alternative livelihoods in rural settings have been associated with capital assets of households (Bennett et al., 2012). The adoption of climate smart farming and other alternative livelihoods projects promoted by Ya'axché has been met with resistance in the case study communities. Research into the barriers as well as enabling environments for the adoption of climate smart farming and alternative livelihoods should be undertaken. A cross case study comparison approach can be undertaken by using the SLA model.

**Livelihood diversification of households:** Several households across the MGL have adopted livelihood strategies promoted by Ya'axché. Households who have adopted these strategies seem to be better off (by generating more income). But according to Ellis (1998) livelihood is

more than income; therefore, research into livelihood security, income increasing capabilities, the role of gender, motivations, risks, and patterns should be undertake. The logit model can be used to guide this endeavor.

**Management and governance effectiveness evaluation of the GSCP:** Households who did not see any tangible benefits from the management of the GSCP expressed negative sentiments towards Ya'axché. Research into the management and governance effectiveness of the GSCP should be undertaken.

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# ANNEXS

Annex 1: Semi-structured questionnaire for determining direct use values of the Golden Stream Corridor Preserve.

No.__

**Techische Universität Dresden**
Institut für Internationale Forst- und Holzwirtschaft
Professur für Tropische Forstwirtschaft

Date:_____
Data collector: _____

**Questionnaire for measuring direct use values of the Golden Stream Corridor Preserve**

**1. Household Information**

| Village: Medina Bank [ ] Golden Stream [ ] Indian Creek [ ] | | | | | | | |
|---|---|---|---|---|---|---|---|
| Demographics | | | | | | | |
| Name (optional) | Sex | Age | Education | Occupation | Household size | # of adults | Ethnicity |
| | | | | | | | |
| | | | | | | | |

**Sex**: Male =1 Female =2
**Education:** none=1 Incomplete=2 Primary=3 Secondary=4 Sixth form=5 Bachelor=6 Graduate=7

1.1 How long have you been living in the community? _____

**2. Household assets**

2.1 Do you own any land in the Village?
Yes [ ] No [ ]

2.1.2 If Yes:

| **Land type** | **Area (acres)** | **Area cultivated (acres)** | **Follow land (acre)** | **Forested (acres)** | **Ownership** |
|---|---|---|---|---|---|
| House lot | | | | | |
| Communal land | | | | | |
| Leased land | | | | | |
| Other: | | | | | |
| | | | | | |

2.2 Do you own any livestock?
Yes [ ] No [ ]

2.2.1 If Yes:

| **Type** | **Quantity (#)** | **Utilization** | | **Live price (BZD/lb)** | **Butchered price (BZD/lb)** |
|---|---|---|---|---|---|
| | | Consumed | Sold | | |
| Chicken | | | | | |
| Pig | | | | | |
| Cow | | | | | |
| Others: | | | | | |
| | | | | | |

**3. Forest Use**

***Construction material***

3.1 Do you collect construction material from the forest?
Yes [ ] No [ ]

3.1.2 If Yes:

| Construction material | Quantity | Frequency | Local Price | Source | Income from sale |
|---|---|---|---|---|---|
| Cohune leaves | | | | | |
| Thatch (bay leaf) | | | | | |
| Posts | | | | | |
| Sticks | | | | | |
| Vines | | | | | |
| Lumber | | | | | |
| Other: | | | | | |
| | | | | | |

**Source:** Golden Stream Corridor Preserve=1; Own land=2; Community Forest=3;
Other: _____

***Fuel wood***

3.2 Do you collect fuelwood from the forest?
Yes [ ] No [ ]

3.2.1 If yes, how often?
[ ] Every day [ ] per week [ ] per month [ ] per year

3.2.2 Describe Fuel:

| Fuel Purpose | Quantity (bundles) | Price (BZD) | Utilization | | Source |
|---|---|---|---|---|---|
| | | | Consumed | Sold | |
| Cooking | | | | | |
| Other: | | | | | |
| | | | | | |

**Source:** Golden Stream Corridor Preserve=1; Own land=2; Community Forest=3;
Other: _____

***Edible forest products (plant)***

3.3 Do you collect edible plants from the forest?
Yes [ ] No [ ]

3.3.2 If yes, describe edible plant product:

| Edible forest product | Frequency | Quantity | Price per units (BZD) | Utilization | | Source |
|---|---|---|---|---|---|---|
| | | | | Consumed | Sold | |
| Fruits: | | | | | | |
| | | | | | | |
| Jipjapa | | | | | | |
| Cohune cabbage | | | | | | |
| Bay leaf cabbage | | | | | | |
| Pacaya | | | | | | |
| Other: | | | | | | |

**Source:** Golden Stream Corridor Preserve=1; Own land=2; Community Forest=3;
Other: _____

***Medicinal plants***

3.4 Do you collect medicinal plants from the forest?
Yes [ ] No [ ]

3.4.1 If yes, how often?
[ ] Every day [ ] per week [ ] per month [ ] per year

3.4.2 If yes, Describe medicinal plant:

| Name | Part of plant collected | Used for | Quantity | Utilization | | Source |
|---|---|---|---|---|---|---|
| | | | | Consumed | Sold | |
| | | | | | | |
| | | | | | | |

**Source:** Golden Stream Corridor Preserve=1; Own land=2; Community Forest=3;
Other: _____

***Game meat***

3.5 Do you hunt for game?
Yes [ ] No [ ]

3.5.1 If yes, how often?
[ ] Every day [ ] per week [ ] per month [ ] per year

3.5.2 If yes, Describe game species:

| Name | Quantity | Price (BZD/lb) | Utilization | | Source |
|---|---|---|---|---|---|
| | | | Consumed | Sold | |
| | | | | | |
| | | | | | |

**Source:** Golden Stream Corridor Preserve=1; Own land=2; Community Forest=3;
Other: _____

***Other non-timber forest products***

3.7 Do you collect other non-timber forest products (NTFP) from the area?
Yes [ ] No [ ]

3.7.1 If yes, how often?
[ ] Every day [ ] per week [ ] per month [ ] per year

3.7.2 If yes, Describe NTFP:

| Name | Quantity | Price (BZD) | Utilization | | Source |
|---|---|---|---|---|---|
| | | | Consumed | Sold | |
| Waja leaf | | | | | |
| Tie tie | | | | | |
| Cohune nuts | | | | | |
| Jijpijapa leaf | | | | | |
| | | | | | |

**Source:** Golden Stream Corridor Preserve=1; Own land=2; Community Forest=3;
Other: _____

**4. Income from crops**

***Agricultural crops***

4.1 Did you produce agricultural crops in the last planting season?
Yes [ ] No [ ]

4.1.2 If yes, describe:

| **Crops** | **Output (lbs harvested)** | **Utilization** | | **Price/unit (BZD)** |
|---|---|---|---|---|
| | | Consumed | Sold | |
| White corn | | | | |
| Yellow corn | | | | |
| Red Kidney Beans | | | | |
| Black beans | | | | |
| Vine beans | | | | |
| Pumpkin | | | | |
| Hot peppers | | | | |
| Plantains | | | | |
| Banana | | | | |
| Coco yam | | | | |
| Cassava | | | | |
| Okra | | | | |
| | | | | |
| | | | | |

***Income from bee keeping***

4.2 Do you or any household member do apiculture?
Yes [ ] No [ ]

4.2.1 If yes, describe:

| **# of colonies** | **lbs harvested** | **Frequency** | **Price (BZD)** | **Utilization** | |
|---|---|---|---|---|---|
| | | | | **Consumed** | **Sold** |
| | | | | | |
| | | | | | |

***Income from agroforestry***

4.3 Do you or any household member practice agroforestry
Yes [ ] No [ ]

4.3.1 If yes, describe:

| **Agro. Forestry crop** | **Size (acres)** | **Output (lbs harvested)** | **Utilization** | | **Price/unit (BZD)** |
|---|---|---|---|---|---|
| | | | **Consumed** | **Sold** | |
| Cacao | | | | Dry | |
| | | | | Wet | |
| Coffee | | | | | |
| Spices | | | | | |
| | | | | | |

**5. Income dependent on the Golden Stream Corridor Preserve**

***Income from employment***

5.1 Are you or any family member in the household employed by the Yaaxché Conservation Trust/Golden Stream Corridor Preserve?

Yes [ ] No [ ]

5.1.2 If yes, describe:

| Job tittle | Income (BZD/month) | # of years of employment |
|---|---|---|
| | | |
| | | |

5.2 Do you or a family member have income dependent on the tourism operation of the Yaaxché Conservation Trust/Golden Stream Corridor Preserve?

Yes [ ] No [ ]

5.2.1 If yes, describe:

| Activity | Income (BZD/month) | # Months of income generation | Comments |
|---|---|---|---|
| | | | |
| | | | |

**6. Other source of income**

6.1 Do you or a family member have other income generating activity?

Yes [ ] No [ ]

6.1.2 If yes, describe:

| Activity/job | Income (BZD/month) | # Months of income generation/year | # of years since employment | Comments |
|---|---|---|---|---|
| | | | | |
| | | | | |

**7. Benefits from Ya'axché Conservation Trust**

7.1 Do you receive any extension services, training or other benefits from the Ya'axché Conservation Trust?

Yes [ ] No [ ]

7.1.2 If yes describe:

| Type of service | Frequency | Description |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**Additional comments**

……

……

……

……

……

……

***End***

Annex 2: Open ended questions used during interview with community leaders.

How and when was the community established?

How much communal land does the village own?

What is the role of the village chair person?

What is the role of the *Alcalde*?

How many inhabitants currently live in the community?

What type of infrastructure is there in the community?

What are the customary rules related to:
land use?

forest use?

Annex 3: Non-parametric Kruskall-Wallis and post hoc test to determine if the distribution and mean subsistence incomes from the utilization forest products were statistically different amongst households at Medina Bank.

| Sample1-Sample2 | Test Statistic | Std. Error | Std. Test Statistic | Sig. | Adj.Sig. |
|---|---|---|---|---|---|
| NTFPs-Edible Forest Product | 13.667 | 4.965 | 2.753 | .006 | .035 |
| NTFPs-Fuel Wood | 14.222 | 4.965 | 2.865 | .004 | .025 |
| NTFPs-Construction Material | 25.222 | 4.965 | 5.080 | .000 | .000 |
| Edible Forest Product-Fuel Wood | -.556 | 4.965 | -.112 | .911 | 1.000 |
| Edible Forest Product-Construction Material | 11.556 | 4.965 | 2.328 | .020 | .120 |
| Fuel Wood-Construction Material | 11.000 | 4.965 | 2.216 | .027 | .160 |

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Annex 4: Non-parametric Kruskall-Wallis and post hoc test to determine if the distribution and mean subsistence incomes from the utilization forest products were statistically different amongst households at Golden Stream.

Each node shows the sample average rank of Type_F_product.

| Sample1-Sample2 | Test Statistic | Std. Error | Std. Test Statistic | Sig. | Adj.Sig. |
|---|---|---|---|---|---|
| Other NTFP-Fuel Wood | 18.567 | 6.373 | 2.913 | .004 | .021 |
| Other NTFP-Edible plants and bush meat | 28.400 | 6.373 | 4.456 | .000 | .000 |
| Other NTFP-Construction Material | 39.433 | 6.373 | 6.188 | .000 | .000 |
| Fuel Wood-Edible plants and bush meat | -9.833 | 6.373 | -1.543 | .123 | .737 |
| Fuel Wood-Construction Material | -20.867 | 6.373 | -3.274 | .001 | .006 |
| Edible plants and bush meat-Construction Material | 11.033 | 6.373 | 1.731 | .083 | .500 |

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

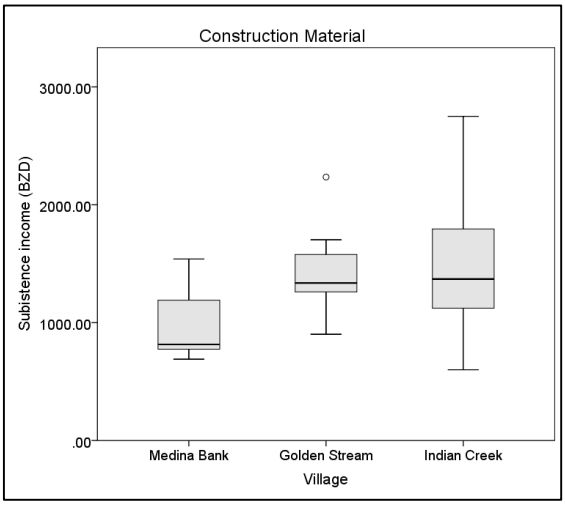
Annex 5; Non-parametric Kruskall-Wallis and post hoc test to determine if the distribution and mean subsistence incomes from the utilization forest products were statistically different amongst households at Indian Creek.

Each node shows the sample average rank of Source.

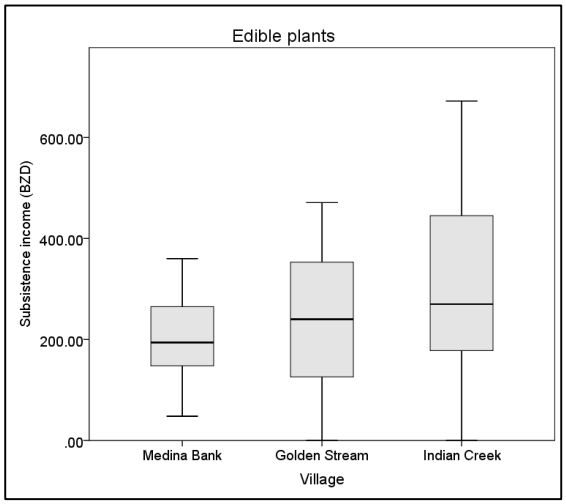
| Sample1-Sample2 | Test Statistic | Std. Error | Std. Test Statistic | Sig. | Adj.Sig. |
|---|---|---|---|---|---|
| NTFP-Bushmeat | 30.806 | 12.271 | 2.510 | .012 | .121 |
| NTFP-Edible plants | 49.764 | 12.271 | 4.055 | .000 | .001 |
| NTFP-Fuelwood | 62.458 | 12.271 | 5.090 | .000 | .000 |
| NTFP-Construction material | 120.097 | 12.271 | 9.787 | .000 | .000 |
| Bushmeat-Edible plants | -18.958 | 12.271 | -1.545 | .122 | 1.000 |
| Bushmeat-Fuelwood | 31.653 | 12.271 | 2.580 | .010 | .099 |
| Bushmeat-Construction material | 89.292 | 12.271 | 7.277 | .000 | .000 |
| Edible plants-Fuelwood | 12.694 | 12.271 | 1.035 | .301 | 1.000 |
| Edible plants-Construction material | 70.333 | 12.271 | 5.732 | .000 | .000 |
| Fuelwood-Construction material | 57.639 | 12.271 | 4.697 | .000 | .000 |

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

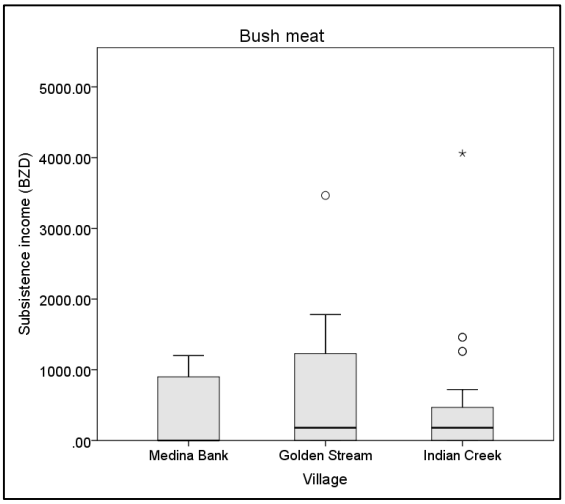
Annex 6: Comparison of the distribution and average subsistence income obtained by communities from the collection of construction material (I), edible plant products (II), hunting for bush meat (III), gathering of fuel wood (IV), and non-timber forest products (NTFPs).



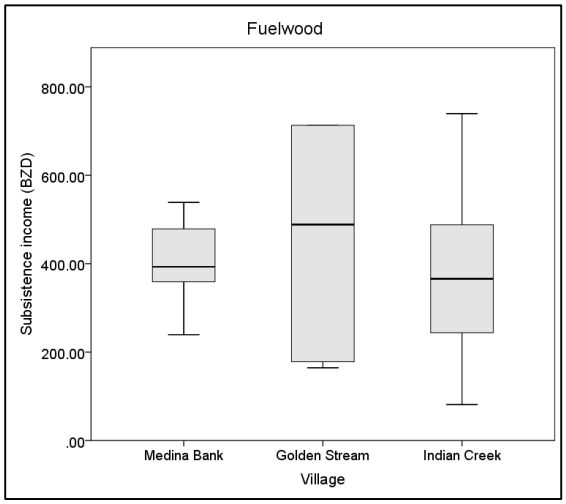

I



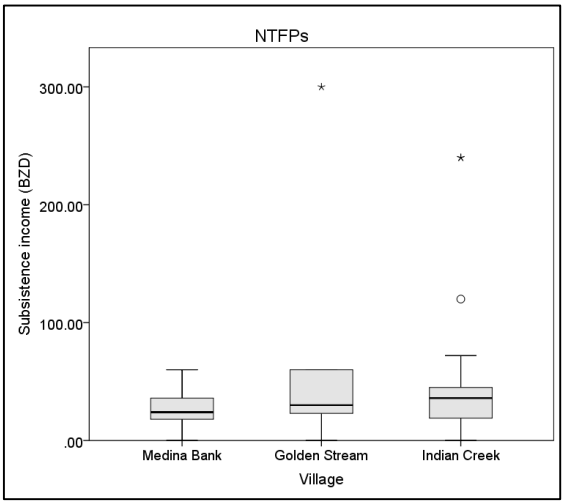

II




III




IV




V

Annex 7: Pearson correlation between household incomes and demographic characteristics of households at Medina Bank.

**Correlations**

| | | Medina Fsub | Medina Yrs | Medina HSize | Medina adults | Medina SubAgric | Medina Edu | Medina CashAgric | Medina_H Income | Medina offsiteInc | Medina LandSize |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Medina Fsub | Pearson Correlation | 1 | .436 | -.138 | -.013 | .493 | -.343 | .761* | .731* | .629 | -.042 |
| | Sig. (2-tailed) | | .240 | .723 | .973 | .178 | .366 | .017 | .025 | .070 | .921 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina Yrs | Pearson Correlation | .436 | 1 | .633 | .742* | .795* | -.825** | .575 | .682* | .612 | .715* |
| | Sig. (2-tailed) | .240 | | .068 | .022 | .010 | .006 | .106 | .043 | .080 | .046 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina HSize | Pearson Correlation | -.138 | .633 | 1 | .948** | .687* | -.524 | .205 | .071 | -.006 | .810* |
| | Sig. (2-tailed) | .723 | .068 | | .000 | .041 | .147 | .596 | .856 | .988 | .015 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina adults | Pearson Correlation | -.013 | .742* | .948** | 1 | .744* | -.629 | .293 | .293 | .229 | .904** |
| | Sig. (2-tailed) | .973 | .022 | .000 | | .022 | .070 | .444 | .445 | .553 | .002 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina SubAgric | Pearson Correlation | .493 | .795* | .687* | .744* | 1 | -.628 | .484 | .472 | .331 | .717* |
| | Sig. (2-tailed) | .178 | .010 | .041 | .022 | | .026 | .187 | .199 | .384 | .045 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina Edu | Pearson Correlation | -.343 | -.825 | -.524 | -.629 | -.628 | 1 | -.321 | -.457 | -.380 | -.692 |
| | Sig. (2-tailed) | .366 | .006 | .147 | .070 | .026 | | .400 | .216 | .313 | .057 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina CashAgric | Pearson Correlation | .761* | .575 | .205 | .293 | .484 | -.321 | 1 | .828** | .763* | .391 |
| | Sig. (2-tailed) | .017 | .106 | .596 | .444 | .187 | .400 | | .006 | .017 | .339 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina H_Income | Pearson Correlation | .731* | .682* | .071 | .293 | .472 | -.457 | .828** | 1 | .983** | .401 |
| | Sig. (2-tailed) | .025 | .043 | .856 | .445 | .199 | .216 | .006 | | .000 | .325 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina offsiteInc | Pearson Correlation | .629 | .612 | -.006 | .229 | .331 | -.380 | .763* | .983** | 1 | .369 |
| | Sig. (2-tailed) | .070 | .080 | .988 | .553 | .384 | .313 | .017 | .000 | | .368 |
| | N | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| Medina LandSize | Pearson Correlation | -.042 | .715* | .810* | .904** | .717* | -.692 | .391 | .401 | .369 | 1 |
| | Sig. (2-tailed) | .921 | .046 | .015 | .002 | .045 | .057 | .339 | .325 | .368 | |
| | N | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Annex 8: Pearson correlation between household incomes and demographic characteristics of households at Golden Stream.

**Correlations**

| | | GoldenSFSub | Golden Yrs | Golden Hsize | Golden adult | Golden edu | Golden offSite | Golden SubAgric | Golden CashAgric | Golden H_Income | Golden Landsize |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Golden FSub | Pearson Correlation | 1 | .041 | .370 | .163 | -.023 | .345 | .514* | .100 | .513 | -.034 |
| | Sig. (2-tailed) | | .886 | .175 | .562 | .935 | .208 | .050 | .724 | .050 | .905 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden Yrs | Pearson Correlation | .041 | 1 | -.003 | .208 | -.693 | -.236 | -.132 | .109 | -.120 | .611* |
| | Sig. (2-tailed) | .886 | | .991 | .458 | .020 | .398 | .639 | .700 | .669 | .015 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden Hsize | Pearson Correlation | .370 | -.003 | 1 | .686** | -.155 | .060 | .453 | .128 | .223 | -.149 |
| | Sig. (2-tailed) | .175 | .991 | | .005 | .582 | .831 | .090 | .650 | .424 | .595 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden adult | Pearson Correlation | .163 | .208 | .686** | 1 | .110 | .150 | .397 | .168 | .275 | .148 |
| | Sig. (2-tailed) | .562 | .458 | .005 | | .697 | .594 | .143 | .549 | .321 | .598 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden edu | Pearson Correlation | -.023 | -.693 | -.155 | .110 | 1 | .322 | -.083 | -.207 | .252 | -.028 |
| | Sig. (2-tailed) | .935 | .020 | .582 | .697 | | .046 | .769 | .459 | .366 | .921 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden offSite | Pearson Correlation | .345 | -.236 | .060 | .150 | .322 | 1 | .071 | -.090 | .739** | -.200 |
| | Sig. (2-tailed) | .208 | .398 | .831 | .594 | .046 | | .800 | .750 | .002 | .475 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden SubAgric | Pearson Correlation | .514* | -.132 | .453 | .397 | -.083 | .071 | 1 | .479 | .516* | -.281 |
| | Sig. (2-tailed) | .050 | .639 | .090 | .143 | .769 | .800 | | .071 | .049 | .310 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden CashAgric | Pearson Correlation | .100 | .109 | .128 | .168 | -.207 | -.090 | .479 | 1 | .572* | -.095 |
| | Sig. (2-tailed) | .724 | .700 | .650 | .549 | .459 | .750 | .071 | | .026 | .737 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden H_Income | Pearson Correlation | .513 | -.120 | .223 | .275 | .252 | .439** | .516* | .572* | 1 | -.238 |
| | Sig. (2-tailed) | .050 | .669 | .424 | .321 | .366 | .002 | .049 | .026 | | .394 |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Golden Landsize | Pearson Correlation | -.034 | .611* | -.149 | .148 | -.028 | -.200 | -.281 | -.095 | -.238 | 1 |
| | Sig. (2-tailed) | .905 | .015 | .595 | .598 | .921 | .475 | .310 | .737 | .394 | |
| | N | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Annex 9: Pearson correlation between household incomes and demographic characteristics of households at Indian Creek.

**Correlations**

| | | Indian FSub | Indian Yrs | Indian Hsize | Indian adult | Indian edu | Indian Offsite | Indian SubAgric | Indian CashAgric | Indian H_Income | Indian Landsize |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Indian FSub | Pearson Correlation | 1 | .138 | -.094 | .031 | -.099 | .028 | .035 | .173 | .181 | .306 |
| | Sig. (2-tailed) | | .422 | .585 | .858 | .567 | .872 | .838 | .312 | .292 | .069 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian Yrs | Pearson Correlation | .138 | 1 | .078 | .098 | -.094 | .068 | .170 | .031 | .110 | .414* |
| | Sig. (2-tailed) | .422 | | .651 | .569 | .587 | .693 | .322 | .856 | .523 | .012 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian Hsize | Pearson Correlation | -.094 | .078 | 1 | .767** | .169 | -.027 | .249 | -.085 | -.023 | -.020 |
| | Sig. (2-tailed) | .585 | .651 | | .000 | .324 | .876 | .143 | .623 | .894 | .909 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian adult | Pearson Correlation | .031 | .098 | .767** | 1 | .077 | .087 | .222 | -.034 | .109 | .014 |
| | Sig. (2-tailed) | .858 | .569 | .000 | | .655 | .613 | .192 | .842 | .529 | .935 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian edu | Pearson Correlation | -.099 | -.094 | .169 | .077 | 1 | -.209 | .014 | -.090 | -.231 | -.175 |
| | Sig. (2-tailed) | .567 | .587 | .324 | .655 | | .222 | .934 | .602 | .176 | .308 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian Offsite | Pearson Correlation | .028 | .068 | -.027 | .087 | -.209 | 1 | -.096 | -.041 | .946** | .117 |
| | Sig. (2-tailed) | .872 | .693 | .876 | .613 | .222 | | .576 | .810 | .000 | .497 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian SubAgric | Pearson Correlation | .035 | .170 | .249 | .222 | .014 | -.096 | 1 | .147 | .075 | .393* |
| | Sig. (2-tailed) | .838 | .322 | .143 | .192 | .934 | .576 | | .393 | .663 | .018 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian CashAgric | Pearson Correlation | .173 | .031 | -.085 | -.034 | -.090 | -.041 | .147 | 1 | .237 | -.060 |
| | Sig. (2-tailed) | .312 | .856 | .623 | .842 | .602 | .810 | .393 | | .164 | .726 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian H_Income | Pearson Correlation | .181 | .110 | -.023 | .109 | -.231 | .946** | .075 | .237 | 1 | .178 |
| | Sig. (2-tailed) | .292 | .523 | .894 | .529 | .176 | .000 | .663 | .164 | | .300 |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Indian Lsize | Pearson Correlation | .306 | .414* | -.020 | .014 | -.175 | .117 | .393* | -.060 | .178 | 1 |
| | Sig. (2-tailed) | .069 | .012 | .909 | .935 | .308 | .497 | .018 | .726 | .300 | |
| | N | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).