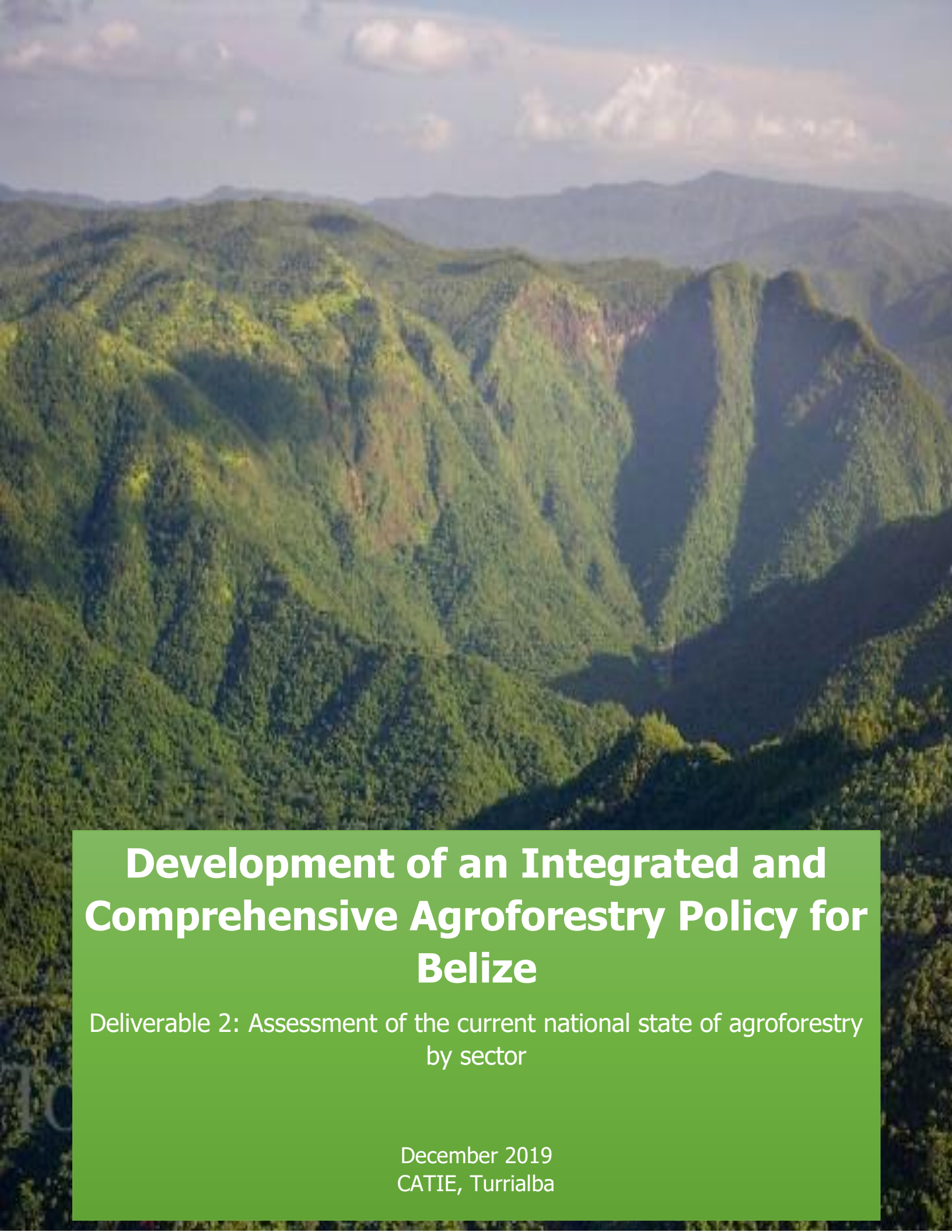


Development of an Integrated and Comprehensive Agroforestry Policy for Belize

Deliverable 2: Assessment of the current national state of agroforestry by sector

December 2019
CATIE, Turrialba

Content

Introduction

Belize provides critical landscape function within Mesoamerica, contributing to the maintenance of regional biodiversity and sustaining viable populations of many species considered threatened throughout their range. Belize's natural resources (including timber, medicinal plants, mangroves, coral reefs, etc.) have contributed towards national and local sustainability.

The potential of agroforestry to contribute to sustainable development has been recognized in international conventions, including the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity, but agroforestry continues to face challenges today. These challenges include unfavourable policy incentives, inadequate knowledge dissemination, legal constraints and poor coordination among the multiple sectors to which it contributes. As a result, its potential contribution to the economy and sustainable development goals has not been fully recognized or capitalized on. For that reason, various initiatives are needed to promote the benefits of agroforestry in Belize.

Forests are not only crucial for the well-being of humanity (FAO, 2000), but it also provides the foundation for life through climate regulation, supply of clean air and water, biodiversity conservation and climate change mitigation. In addition, forests protect soils and water and house more than three quarters of the global terrestrial biodiversity which provides numerous products and services, especially for the poorest people in the world (FAO, 2018).

Deforestation is caused mainly for the conversion of forest land into agriculture and livestock production which as a result threatens livelihoods of foresters, community's forestry and indigenous people, within other. Changes in land use can result in loss of habitats, land degradation, soil erosion and decrease of clean water among others (FAO, 2018).

In addition, water quality is directly related to forest management because fresh water comes from forested river basins which is essential for the health and life of both rural and urban populations. However, more than 40% of the 230 main river basins in the world have lost more than half of its original tree cover (FAO, 2018).

As for Belize, the situation is no different since country's forests provide a range of goods and services which are critical to the health of its economy and well-being of its small national population and is an important contributor to the economy and national development (Forest Department, 2015).

As mentioned in Deliverable 1 (Implementation and Communication Plan) the objective of the Technical Assistance is: "To develop an integrated and comprehensive agroforestry policy framework that will aid in mainstreaming this form of land use countrywide, providing practical knowledge and skills to the national team (National Climate Change Office, the Agriculture

Department and the Forest Department) to understand and use a tested and successful process to develop a National Agroforestry Policy (NAP) of Belize.

Based on the Terms of Reference of the "Development of an integrated and comprehensive agroforestry policy for Belize technical assistance", CATIE is submitting the first set of deliverables from Output 2: National assessment of the current state of agroforestry by sector (base line study). The deliverables addressed are:

Activity 2.1 Review/collection of data/statistics on forest cover & agroforestry systems by district/sector. Kick off mission to meet with Belize's NDE & support team.

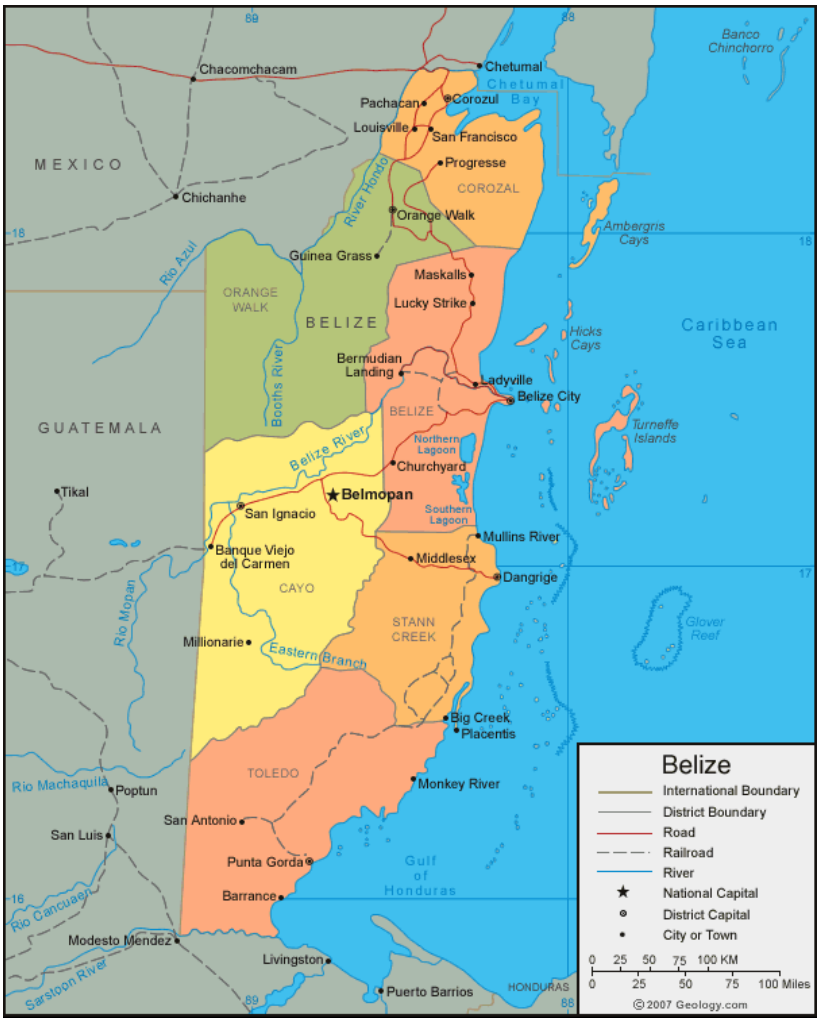
Activity 2.2 Review of current permits and procedures for harvesting/transport/trade of timber produced on farms

Background Information

Belize (Figure 1) is a small subtropical country (22,966 km^2) which was occupied solely by the Maya people before the arrival of the Europeans and British colony (Mitchel et.al., 2017). Belize, formerly known as British Honduras, is located on the east coast of Central America facing the Caribbean Sea (15°53'-18°30'N; 87°15'-89°15'W). The country is bordered on the West and South by Guatemala and North by Mexico. The western, southwestern and southern part of the country holds the "Mayan Mountains", whereby the entire coast and northern part of the country corresponds to the "Low Plains" (Rosa Cruz, 2010; FAO, 2018).

Belize has three distinct physiographic regions: i. the flat northern lowlands, with a complex mosaic of lowland, semi-deciduous forest, savannahs, freshwater rivers and wetlands, with saltwater lagoons and mangroves along the coast; ii. the southern coastal plain that supports the tropical pine and broadleaf forest; and iii. the Maya Mountains of granite quartzite's and shales. Seventy ecosystems have been identified within these broad categories (Salas & Shal, 2015).

Figure 1. Administrative & political Map of Belize



The country holds approximately 1,014 native species of vertebrate and 3,411 native species of plants. The forest cover is estimated in 60% of national land area. Over 100 protected areas cover 35% of the country's total land area and 10.6% percent of the country's total sea area allowing in total protected areas to cover 22.8% of country's national territory (Kay & Avella, 2010).

The country is populated with more than six different ethnic groups each with its unique cultural traditions and languages (Kay and Avella, 2010). Belize's current estimated population is 408,487 inhabitants. From these 44.71% (182,663) live in urban areas, while 55.28% (225,824) live in rural areas (SIB, 2019). Belize has a small economy and it mainly depends on agriculture and tourism, these account for more than half of Belize's economy, whereby contribution alone from agriculture is 13.6% of GDP (SIB, 2019; GoB, 2015).

A Baseline Report with updated statistics on agroforestry systems by districts/sector.

Kay and Avella (2010) mentioned that Tropical Forests, such as those found in Belize, are among the most diverse and productive ecosystems because they provide a wide range of economic, social benefit and environmental services through their productivity and diversity. In addition, these forests provide income to industries such as timber, ecotourism and trade of non-timber forest products such as game meat, medicinal plants, edible plants, craft material, palmetto seeds (*Acoelorrhaphe wrightii*) and xaté leaves among others.

Forest cover change declined from 74.4% in the 80's to 62.85% in the early 2010 and 61.6% in early 2012 (Table 1). Belize's deforestation for the period 1980-1989-2000-2004-2010 estimated that the average annual deforestation rate was under 0.6% or 10,117 ha (25,0000 acres/year). While the rate of deforestation was 11,671 ha (or 28,839 acres/year) between 2010-2012. Thus, indicating that the deforestation rate has increased tremendously as compared to previous years. In addition to the amount lost in forest cover it is estimated that another 33,129 ha (81,864 acres) of forest were cleared due to natural disasters such as: fire and hurricane damage. By 2011 forest loss has increased four-folds as a result of natural disaster (Cherrington, 2012).

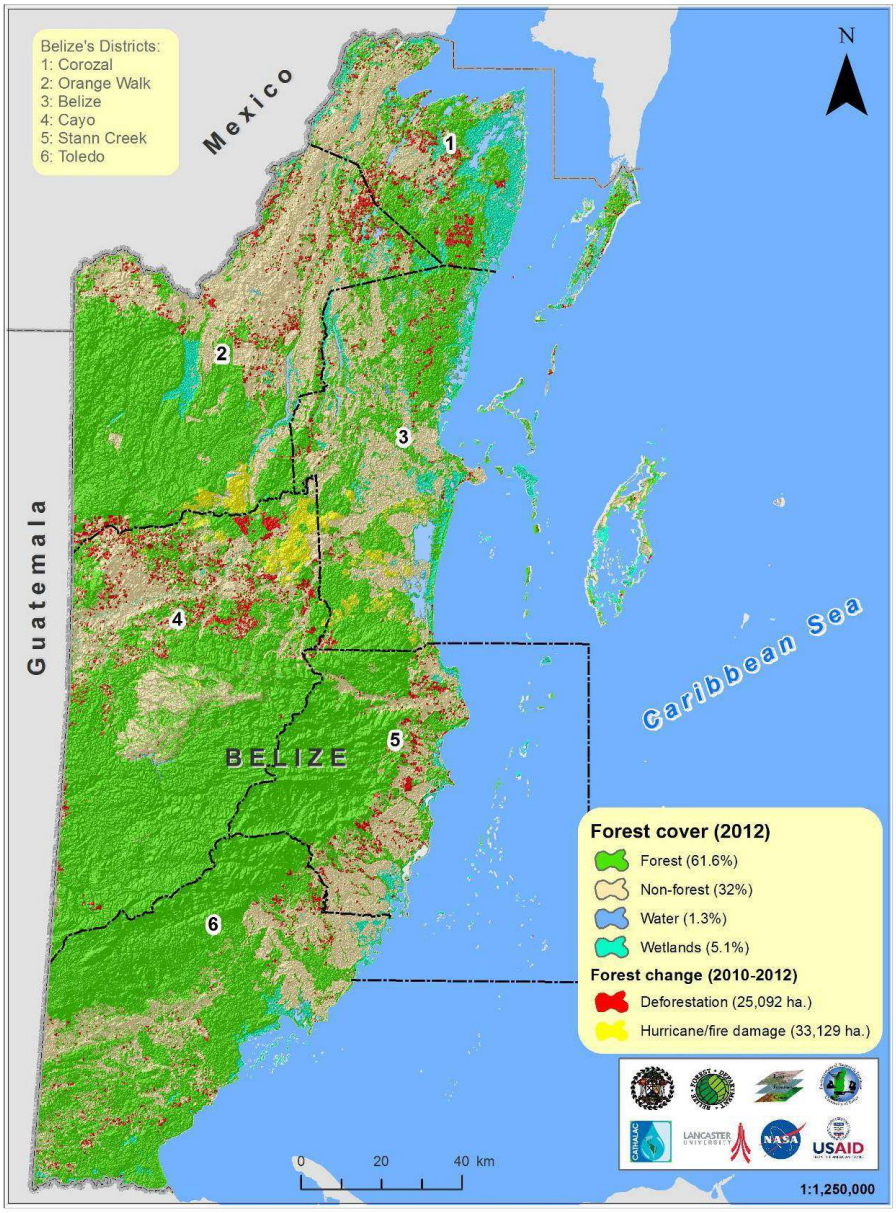
Table 1. Forest Cover between 1980-2012 in Belize.

Year	Forest Cover		Change		Change/yr.		% Forest Cover
	Ha	Acres	Ha	Acres	Ha	Acres	
1980	1,648,783	4,074,228					74.38%
1989	1,616,027	3,993,286	32,756	80,942	3,640	8,994	72.90%
1994	1,536,025	3,795,597	80,002	197,689	17,778	43,931	69.29%
2000	1,459,301	3,606,009	76,724	198,589	12,787	31,598	65.83%
2004	1,416,530	3,500,39	42,771	105,689	10,967	27,100	63.90%
2010	1,391,391	3,438,200	25,139	62,120	4,190	10,353	62.77%
2012	1,366,300	3,376,197	25,092	62,003	11,671	28,839	61.64%

Source: Cherrington (2012)

As mentioned before forest cover in 2012 is at 61.6%, meanwhile non-forest cover is at 32%. Types of forest deforested are broad leaf forest with 24,140 ha, pine forest 710 ha and mangrove 204 ha (Figure 2). Cayo was the district with the highest deforestation (35.1%), followed by Orange Walk with 23.9%, Corozal with 17.7%, Stann Creek 8.1%, Toledo 7.6% and Belize 6.6% (Cherrington et.al., 2012).

Figure 2. Belize's Forest Cover 2012



Source: Cherrington (2012)

It is estimated that 1,603 ha (3,961 acres) or 6.4% of forest were cleared within protected areas. These occurred in four specific protected areas which lie along Belize's Western Border. These areas are: the Caracol Archaeological Reserve, the Chiquibul National Park, the Colombia River Reserve and the Vaca Forest Reserve. Forty percent (40%) of the deforestation occurred in the Belize River watershed during the period of 2010 – 2012 (Table 2), followed by New River, Rio Hondo, and Northern River (Cherrington, 2012).

Table 2. Deforestation in watershed in Belize.

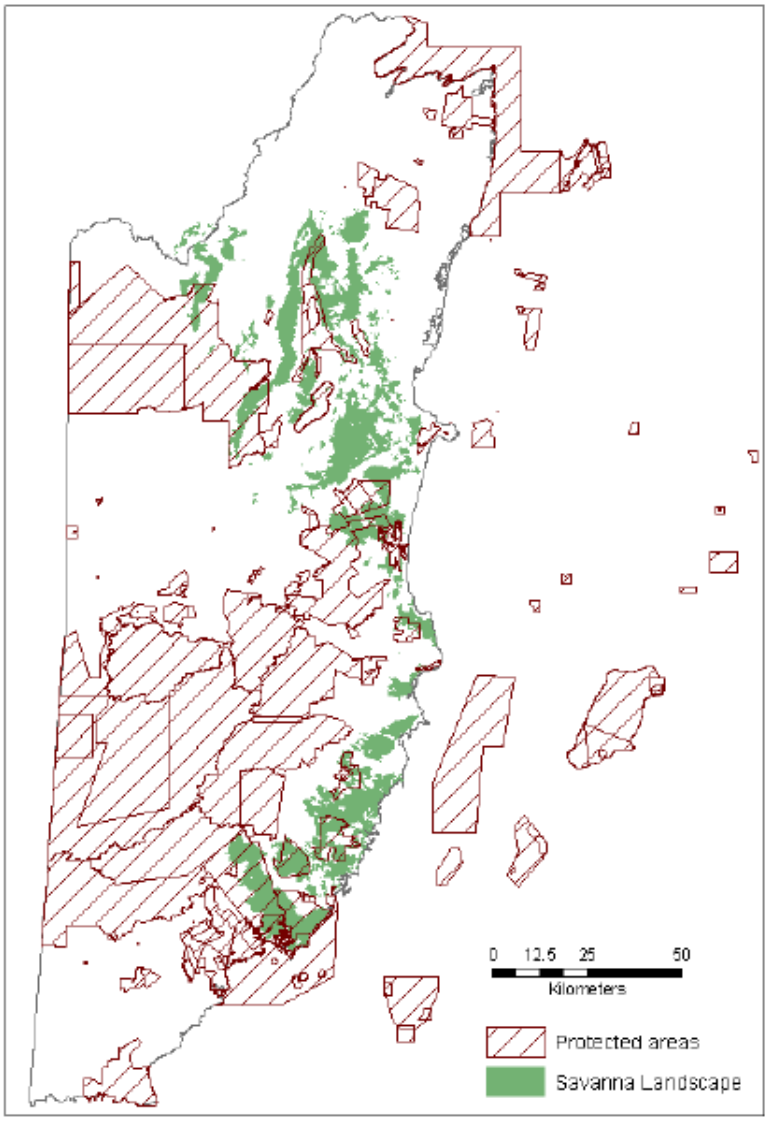
Major Watershed	Deforested (2010-2012)		
	Ha	Acres	%
Belize River	9,201	22,737	36.70%
New River	2,458	6,073	9.80%
Rio Hondo	2,314	5,717	9.20%
Northern River	2,062	5,096	8.20%
Sibun River	1,553	3,836	6.20%
Monkey River	778	1,921	3.10%
Moho River	411	1,015	1.60%
Temash River	309	763	1.20%
Sittee River	240	594	1.00%
Rio Grande	224	552	0.90%
North Stann Creek	220	544	0.90%
Sarstoon River	133	330	0.50%
South Stann Creek	85	210	0.30%
Mullins River	63	156	0.30%
Golden Stream	39	96	0.20%
Deep River	30	74	0.10%
Sub-total: Major Watershed	**20,118**	**49,712**	**80.20%**
Sub-total: Non-Major Watershed	**4,974**	**12,291**	**19.80%**
Total	**25,092**	**62,003**	**100%**

Source: Cherrington (2012)

Historically, forestry and the logging were the main economic activities in the country. But presently, agriculture (crop and horticulture production) and livestock production have become important economic activities along with tourism. Based on data from the Belize Tourism Board in 2007, a total of 289,986 tourists visited three of the forested protected areas (which are co-managed by the Belize Audubon Society), The Mountain Pine Ridge Forest Reserve and 12 archaeological sites in the country (Kay and Avella 2012). Tourism in Belize is primarily natural and cultural-resource based, with visitors focusing on the cayes, coastal communities and coral reef, inland protected areas and Maya sites (Mitchell, et.al., 2017).

Savanna represents 10% of the national territory (Cameron et.al., 2011). Lowland savannas in Belize are threatened by a combination of human pressures for settlement, infrastructure and climate change (Figure 3). It has been noted that aquaculture and agriculture have had dramatic impact upon the lowland savannas nationwide. Unfortunately, they are responsible for altering the drainage, nutrient cycling and fire regimes causing degradation of the savanna ecosystem (Cameron et.al., 2011).

Figure 3. Savanna vs Protected Areas in Belize



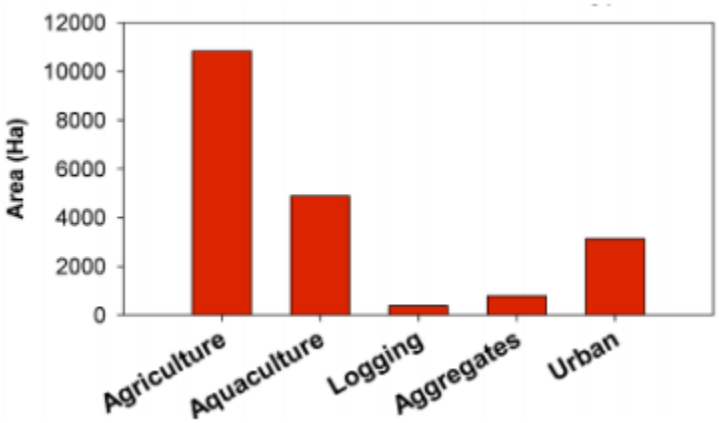
Source: Cameron et.al, (2011)

Twelve percent (12%) of lowland savanna has been lost to various development, whereby agriculture and aquaculture has been two of the largest sources of development and have accounted for almost 80% of the area lost in the savanna. Aquaculture activities are being carried out in the Stann Creek and Toledo districts. As a result, this activity has generated revenues of Bze$ 84.20 million by 2004 (Cameron et.al, 2011).

Meanwhile, as shown in Figure 4, land has been converted mostly for agriculture/pastures. This has occurred more frequently in the northern district (Orange Walk) and western district (Cayo), while smallholder agriculture has occurred in many districts. Papaya, banana and limited rice

production can be seen in low lying areas close to water sources in savannas from the southern plains.

Figure 4. Land Use change in Belize's Lowland Savanna



Source: Cameron et.al (2012)

As for infrastructure (aggregates & urban), the largest airstrips (Philip S.W. Goldson Int'l Airport and Placencia Airport) along with main highways have been established in these savanna areas, as well as the city of Belmopan, residential area Mahogany Heights, and municipal waste disposal site have been constructed in these areas (Table 3)(Cameron et.al., 2012).

Table 3. Estimated area of Savanna converted to other uses

Land Use	Estimated area of savanna converted to other uses (ha)
Agriculture/Pasture	10,844
Aquaculture	4,884
Logging	373
Aggregates	782
Urban	3,129

Source: Cameron et al. (2012)

Agriculture Production in Belize

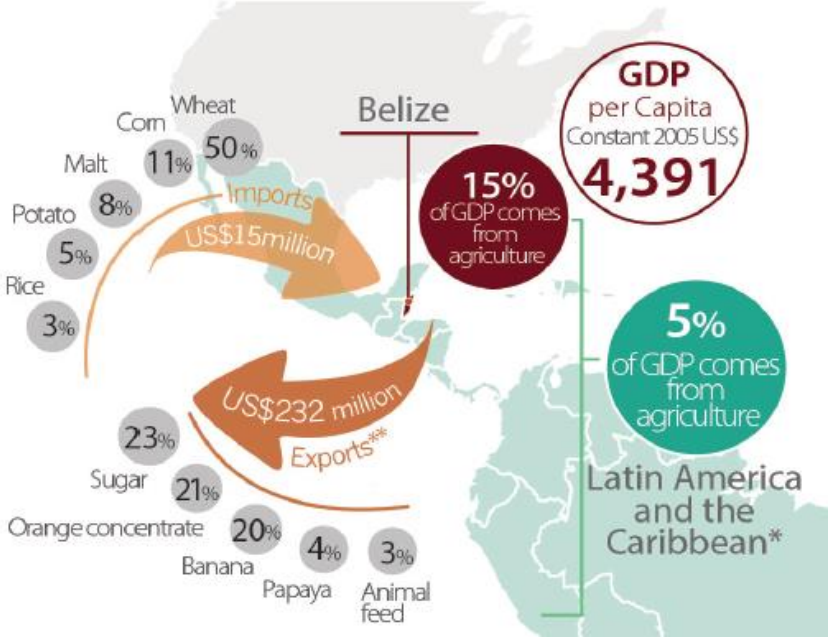
Agriculture, as mentioned before, is one of the main pillars in Belize's economy, which has contributed significantly to the country. The Gross Domestic Product (GDP) contribution from agriculture is 13.6%, its employment is 16% (23 400 people) (GOB, 2015); making it a major

source of income, foreign exchange earnings, and food and nutrition security for the country (World Bank, 2018).

Agriculture in the country is characterized by three main subsectors: i. a well-organized export-oriented commercial subsector specializing mainly in banana, citrus, and sugar; ii. a highly diverse, subsistence-oriented smallholder subsector producing a wide range of food crops, that is, vegetables which is used mainly for local consumptions; and iii. a vertically integrated large-scale commercial subsector which is dominated by the Mennonites producing cereals and livestock products for both local and international markets (World Bank, 2019).

Leading agricultural exports during 2011-2015 were sugar, orange concentrate, banana, papayas and animal feed generating almost US $232 million per year, while import generated only US $15 million per year (Figure 5), these products include wheat, corn flour, malt, potatoes and rice, as well as live cattle and specialty cuts of meat which were directed mainly for the tourism market (World Bank, 2019).

Figure 5. Economic relevance of agriculture in Belize



Source: World Bank, 2019

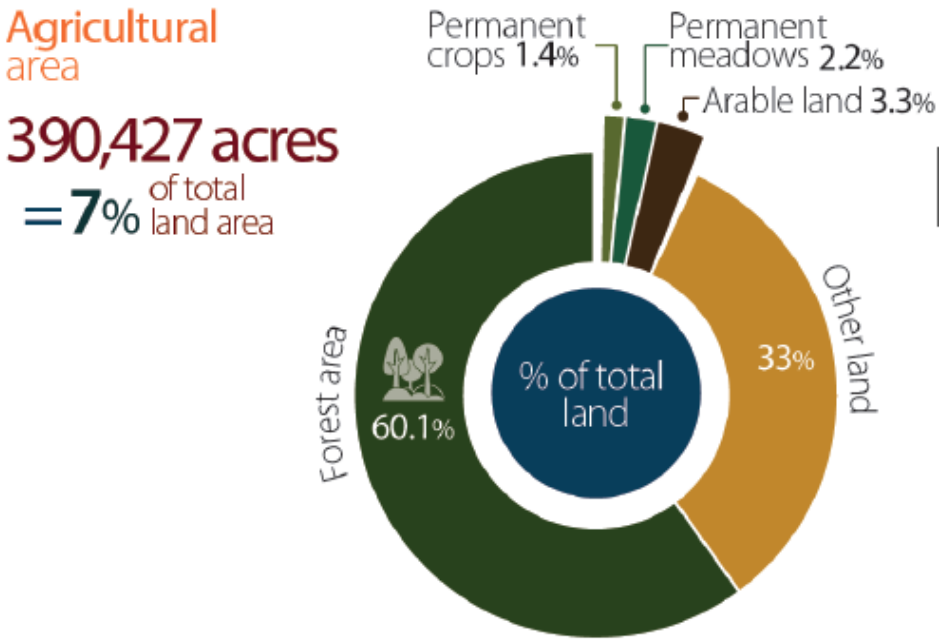
Belize currently has approximately 10,000 farms of which 75% are considered small farms corresponding to 10 ha or less. Many of these small farmers have mixed farms which include livestock and crop production, both for subsistence and income generation. Toledo District contains 25% of all farms in Belize and represents most of the small farms in the country. Meaning that 77% of these small farms are below 20 acres followed by Orange Walk and Corozal respectively (World Bank, 2018).

According to Avila (1998), Levasseur (2000), Konsager (2017) the main land use system in Belize are:

1. The milpa base system- that is shifting cultivation, this occupies 2% of the country. This is practiced mainly in the Toledo, Cayo and Orange Walk.
2. Sugarcane- occupies 3% of the total land area, this is practiced in Orange Walk and Corozal and recently in Cayo.
3. Citrus- this is practiced mainly in the Stann Creek and Cayo.
4. Banana- occupies 1% of the total land area, this practiced mainly in the Stann Creek and Toledo.

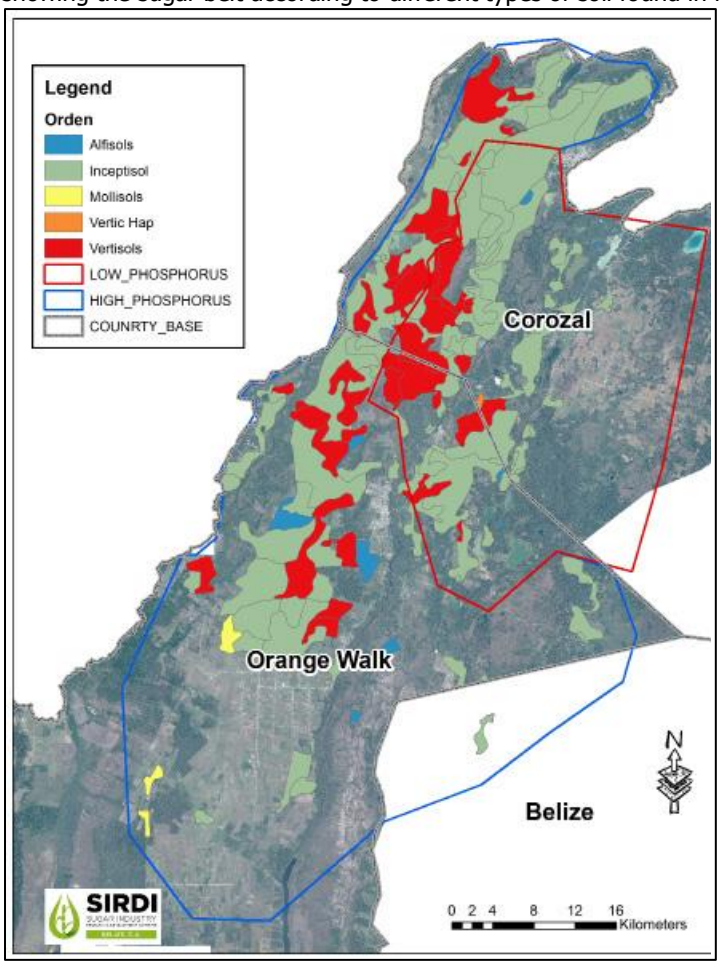
Agriculture activity in Belize is diverse. Crops such as corn, beans and vegetables are produced in the whole country through various practices ranging from subsistence oriented shifting cultivation to fully mechanized commercial operations. Only 7% of the total land area is being used for agriculture (Figure 6), where 1.4% is planted with permanent crops, 2.2% consists of permanent meadows and 3.3% is arable land (World Bank, 2018).

Figure 6. Agricultural land distribution in Belize



Sugarcane for sugar production are planted on approximately 37,231 ha (Figure 7), citrus is planted on 19,425 ha and corn is planted on 19,627 ha (World Bank, 2018). Westby (2019) mentions that according to the Sugar Industry Management Information System (SIMIS) survey, which was held in 2018, the estimated area for sugar production in Northern Belize was 33,916 ha, with Corozal having 14,731 ha and Orange Walk a total of 19,185 ha.

Figure 7. Map showing the sugar belt according to different types of soil found in Northern Belize.



Source: SIRDI, (2019)

The current total production of the industry is about 1.35-1.45 metrics tons of cane and 115,000 – 125,000 tons of sugar (SCPC, 2015). Seventy seven (77%) of producers are classified as small scale, delivering volumes of less than 200 tons of cane per cycle and with an estimated average productivity of 44 ton/ha (Westby, 2019). According to the FAO Stats (2017) harvested area per crops produced in Belize are shown in Table 4 and Figure 8.

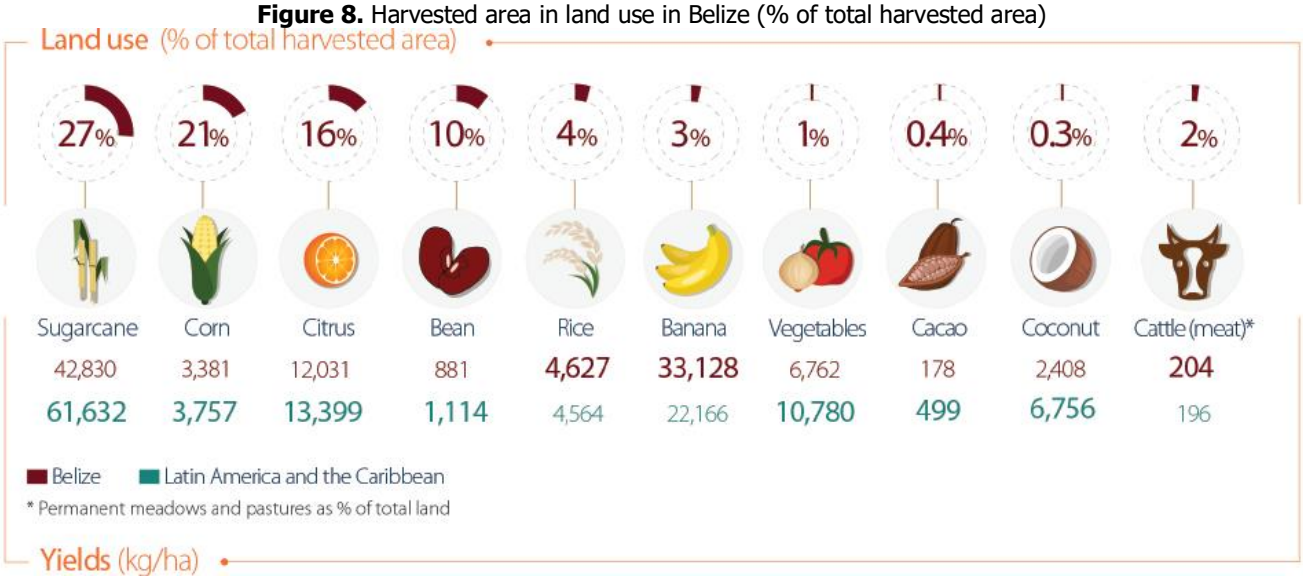
Table 4. Harvested area per crop produced in Belize.

Crop	Harvested Area (ha)
Sugarcane	37,247
Corn	19,641
Oranges	13,135
Bean Dry	8,502
Rice Paddy	3,972
Soybean	3,684

Bananas	3,472
Grapefruit	2,178
Coconuts	940
Cacao	410
Papaya	150
Bean Green	100
Melons	83
Cassava	46
Carrots	40
Okra	9
Mangoes, Guava and Mangosteen	5

Source: FAO stats (2017)

Figure 8. Harvested area in land use in Belize (% of total harvested area)



According to the Ministry of Agriculture 2018 production of grains, beans & sugar are the following (Table 5); the Toledo district records the most production (lbs) of white corn, followed by black beans, rice, yellow corn and red kidney beans respectively. The Stann Creek district also records the highest production of yellow corn (lbs) 774,000 followed by white corn, black beans and red kidney beans. The Cayo and Orange Walk district shows diversity in grains, beans and sugar production whereby, yellow corn registers the highest production (134, 591,300 lbs) and Rice (16, 804,000 lbs). Belize district also registers the highest production of white corn (136,250 lbs) and Corozal with 11,320,000 lbs of Sorghum.

Table 5. Grain, Beans & Sugar production (lbs) per district in Belize.

Grains, Beans & Sugar	**Toledo**	**Stann Creek**	**Cayo**	**Belize**	**O Walk**	**Corozal**
Black Beans	2,462,000	236,700	465,500	14,400	113,000	3,581,500
Red Kidney Beans	28,100	147,600	5,333,850	3,200	391,200	6,083,900

Cowpea (Blackeye peas)			2,991,700		414,700	
Pinto Beans			43,200		13,500	522,600
Other Beans			96,800		68,000	
Yellow Corn	901,000	774,000	134,591,300	115,000	15,905,499	
White Corn	4,117,000	565,500	8,310,800	136,250		4,621,550
Rice	2,289,155		10,394,000		16,804,000	1,404,900
Sorghum			1,453,700		5,305,000	11,320,000
Soybeans			14,930,387		2,031,000	
Sugar			432,530		1,275,007	
Cotton					20,000	

Source: Ministry of Agriculture (2020)

As for vegetable production (Table 6), shows production per district, whereby Stann Creek, Cayo, Corozal has more diversity. Stann Creek registers the highest production in hot pepper (453,825 lbs), irish potato (2, 843, 880 lbs) and onion (1,244,450 lbs) respectively.

Table 6. Vegetable production (lbs) per district in Belize

Vegetables	**Toledo**	**Stann Creek**	**Cayo**	**Belize**	**O Walk**	**Corozal**
Cabbage	1,425	59,866	1,606,500	109,500	180,000	717,502
Cucumber	16,050	12,000	268,500	365,516		89,400
Hot Pepper		453,825	84,625	127,500	15,000	79,100
Okra		500	34,125			
Squash			351,750			9,000
Pumpkin		50,000	240,000			4,350
Sweet pepper	16,110	68,900	896,750	1,643,000	21,000	321,000
Tomatoes	3,425	21,000	1,687,350	2,033,600	100,000	830,305
Irish potato			2,843,880		270,000	280,810
Onion		5,000	40,000	175,500	317,000	1,244,450
Carrots		290,657	727,200			48,000
String Beans			25,312			21,000
Lettuce		50,005	310,500			
Chinese Cabbage			105,250			
Cauliflower		10,709	79,199			3,600
Sweet Corn (Ears)						36,000
Broccoli		8,000	75,800			
Celery			149,940			
Cho-Cho		17,500	109,200			

Source: Ministry of Agriculture (2020)

In terms of root crop production (Table 7), Toledo, Stann Creek and Cayo are three districts who produce most root crops meanwhile Orange Walk does not produce any type of root crop.

Toledo produced 34,650 lbs of sweet potato, Stann Creek produced 1,210,000 lbs of cassava, Cayo produced 608,500 lbs of coco yams, Corozal produced 75,000 lbs of Jicama and Belize only produced 116,000 lbs of cassava for the year of 2018.

Table 7. Root crop production (lbs) per district in Belize.

Root Crop	Toledo	Stann Creek	Cayo	Belize	O Walk	Corozal
Cassava	63,510	1,210,000	136,500	116,000		4,000
Coco yams	43,030	86,000	608,500			
Ginger	3,450	157,000	150,000			
Sweet potato	34,650	15,000	270,000			10,000
Yam	16,375	40,500	24,750			
Yampi	21,880	35,000	27,500			
Jicama			91,000			75,000

Source: Ministry of Agriculture (2020)

As for Tree Crops and other Fruit products (Table 8) for the year of 2018, shows that Toledo produced 3,384,500 lbs of pineapple, Stann Creek produced 10,725,120 lbs of coconut and 2,433,409 boxes of oranges. In 2018, Cayo also produced 9,216,000 lbs of coconut and 1,389,000 lbs of watermelon, Belize also produced 1,728,000 lbs of coconut and 1, 249,000 lbs of watermelon. Lastly, Orange Walk produced 1,852,800 lbs of mangoes and 1, 951,000 lbs of watermelon.

Table 8. Tree crops & other fruit products (lbs) per district in Belize.

Tree Crops and Other Fruit products	Toledo	Stann Creek	Cayo	Belize	O Walk	Corozal
Citrus Oranges (Boxes)		2,433,409				
Grapefruit (Boxes)		205,475				
Lime Production	320	57,000			40,000	
Mangoes		70,000			1,852,800	
Pineapple	3,384,500	735,000	637,500		60,000	
Plantain	14,599	106,900	35,083	110,000	200,000	
Watermelon	129,100	91,000	1,389,000	1,249,000	5,040,000	1,951,000
Coconut	921,600	10,725,120	9,216,000	1,728,000		979,200
Cocoa	220,462	22,200				
Avocado		2,250				
Canteloupe	18,750		413,250	460,000		330,417
Coffee	65,000					
Apple Banana			6,779			
Peanut			220,000			700
Soursop			279,000			
Papaya						2,703,536

Source: Ministry of Agriculture (2020)

As for livestock production & other animal production (Table 9), in the year 2018, Orange Walk and Cayo has registered the greatest number of cattle heads 85,419 and 46,634 respectively. These two districts also registered the highest in milk production along with poultry (5,504,731 and 6,165,571 slaughtered) and egg (1,143,990 and 3,960,185 doz) production. Stann Creek has registered the highest in honey production 126,262 lbs.

Table 9. Livestock & other animal production (lbs) pero district in Belize.

Livestock	Toledo	Stann Creek	Cayo	Belize	O Walk	Corozal
Cattle (head)	9,914	4,125	46,634	6,845	85,419	
Milk (lbs)	232,621	126,262	7,946,232	3,755	2,700,000	
Honey	10,176	126,262	70,126	100	22,525	15,686
Pigs	2,250	2,850	7,580	4,400	10,300	1,326
Sheep		293	118	996	1,057	
Poultry (slaughtered)			6,165,571		5,504,731	
Layers (Eggs doz)			3,960,185		1,143,990	875
Turkey (Slaughtered)					6,754	

Source: Ministry of Agriculture (2020)

In the last 20 years total area of pastures has been 56,000 ha (World Bank, 2019). This has remained relatively stable, but cattle herd has increased from 57,800 to 97,000 heads, meaning that the stocking rate increase 1.20 to 1.73 animals/ha (CATIE, 2019). According to the FAO (2017) stats, approximately 1,483 tons of Beef have been slaughtered for meat.

Livestock producers in Central America, as in the rest of the world, seek to meet a growing demand for meat and milk which unfortunately puts pressure on natural resources. Livestock production for meat and milk is concentrated mainly in the Cayo District in natural pastures (Detlefsen et.al., 2012).

According to Vidal (2012), in the 1920's timber extraction of selective species such as cedar (*Cedrela odorata*) and mahogany (*Swietenia macrophylla*) was mainly for exploitation purposes and represented 80% of total exports. In 1963, timber exportation had decreased significantly by 15% due to agricultural activities. Since then, timber exploitation has continued to decline due to increase in agriculture activity such as sugar cane, citrus, banana and other crop production. However, since then the Mennonite farmers have been actively working in the logging industry not only for trade but also for household use such as building homes, furniture and fuelwood.

Unfortunately, there is a small portion of timber coming from Silvopastoral Systems (SPS). This type of system has not been widely adopted in Belize due to various limitations such as risk, limited capital and market, and poor genetic stock (Alonzo et al., 2001) and because farmers are reluctant to changes from tradition to new technologies due to lack of knowledge. Farmers do not perceive the necessity to plant trees or conserve them because there is still an abundance of forest cover in Belize, about 61% (Vidal, 2012). Currently, the main source of timber is from the forest.

In Pontara's (2019) investigation "Analysing farmers' perceptions towards agroforestry adoption in Southern Belize" he explained that although farmers in the Toledo district may not know the concept of agroforestry, they understand the concept of mixing trees and crops in interaction. Where farmers have identified and conducted 10 different practices in their farms:

1. Planting lines of corn among rows of Inga trees.
2. Planting and managing home gardens.
3. Planting cacao under natural trees.
4. Planting mucuna beans in the forest.
5. Planting cohune palm in cornfields.
6. Combining animals and trees in interaction.
7. Performing Traditional Mayan planting ritual for non-traditional farming practices.
8. Keeping food for wildlife on the field border.
9. Planting food and timber trees and protecting natural trees.
10. Not using chemicals.

Mayan traditional rituals are also known as nature-based religion or having a spiritual connection to the land. The Mayas offer respect and request permission from the forces of nature before conducting the traditional slash & burn, selection of seeds and planting of seeds.

It is known that practices 7, 8 and 10 from above do not necessarily fit in Somarriba's 1992 definition on agroforestry, but farmers consider these as an agroforestry concept and thus

these are or at some point being practiced in the Toledo district. These agroforestry practices show the new intentions, practical knowledge, local understanding, etc. that there is a new routine behaviour overarching the logic of agroforestry practice (Pontara, 2019). Which is why Pontara (2019), recommended that it is important to agree on one definition that can adopt the international definition in the Belizean context, which considers the local farming systems, needs, traditions, and other relevant aspects.

Farmers also perceive benefits of agroforestry systems, but they also perceived risks and barriers that they consider would affect the implementation of agroforestry systems in their farms (Table 10) (Pontara, 2019).

Table 10. Risks and benefits identified by farmers in the Toledo district for the implementation of agroforestry.

Benefits	Risks	Barriers
Food, seed, wood and leaves can be sold	Tree might not grow	Benefits too unsure, only in the long-term when cultivating trees i.e years instead of months
New source of wood and leaves for the household	Trees might not produce fruits	Crops cannot grow healthy or even bear under the shade of trees
Fruits diversifying household diet	Wildlife may be more likely to eat farming produce with the presence of trees	Pigs left free in the village would eat the tree seeds and damage the seedlings
Planting trees: chance to teach the younger generation about the different tree species	Men may cut trees or steal food	Children, men and wildlife would certainly take advantage of agroforestry products
Planting trees: future benefits for current grandchildren	The slash//burn of other farmers may run out of control and destroy the agroforestry farm	Agroforestry seen as highly time-consuming: impossible for farmer also with a second job
Cool fresh air generated by trees	Severe lack of water may kill trees in the dry season	Lack of market where to sell agroforestry products
Tree help crops in the dry season by keeping more water in the soil; greener and healthier field with agroforestry	Resource invested in experimenting agroforestry may be too much for farmers who do not know how to do it	Lack of knowledge as a barrier to start implementing agroforestry
Differentiation of livelihoods inside the farm	Land tenure issue: some people regard trees as community foods and not owned by the farmer who traditionally work that plot	Regular floods and soil with stones are impossible conditions for trees

Possible income from eco-touristic visits at agroforestry farms		If trees stand in the field, impossible to practice slash & burn
		Lack of seeds and lack of money to eventually buy them
		Cacao tree cannot grow on village soil and are overestimated
		Lack of community cooperation and respect of agreements e.g fire use
		Necessary use of fertiliser to make crops bear in the shade of trees (chemicals)

Source: Pontara (2019)

Even though farmers have faced many barriers to transitioning into a new concept of agroforestry practice, Non-Profit Organizations like Ya'axché have boosted and incentivized farmers to overcome these factors through the donation of seeds, Inga seedling, cacao trees etc. In addition to this, farmers were able to transition into adopting agroforestry systems because they saw the dilemmas and disruptive impacts of the traditional systems. For example, farmers were able to observe the positive effect of Inga trees in corn plantation through neighbouring farms, nearby villages, etc. (Pontara, 2019).

Although the SPS seem to not be easily adopted in the country, the Mennonites in the Cayo District hold some type of SPS which is the system of isolated tree within pastures (Scattered Trees: Timber, shade and fruit) in pastures, trees in line and live fences (Vidal, 2012; Santos, 2012).

Isolated trees may be a relic from former forest or may have been planted or regenerated since pastures were established. It has been determined that lumber harvested from SPS in the Cayo District can generate benefits up to US $3009, that is a value calculated for 123 standing trees/ha after 40 years (Vidal, 2012).

Timber production in SPS has tremendous productive potential. In addition, SPS can be an attractive alternative for farmers due to: i. it being an alternative income; and ii. the administrative process is relatively simple for harvesting and transportation (Detlefsen, 2000). Avila (1998) states that experts in the agricultural area also consider that agroforestry systems are a promising option because they allow farmers to manage trees with crops, grasses or animals on the same land unit, it improves soil properties, improves yield associated to plants, and trees can provide valuable products such as timber, fruits, food and nuts, etc. Farmers in the Toledo district mention planting trees might allow them to sell additional products and can be an affordable supplement to family diets, fruits can be sold and there is increased fuelwood

availability. They also considered using cohune palms, where the leaves can be used for roofing of houses. Other stated that these trees can be beneficial for their grandchildren. Agroforestry in the Toledo district is seen as a good farming practice by some farmers especially for those who do not use slash and burn systems (Pontara, 2019).

Rosa Cruz (2010) conducted a study of SPS in 35 farms in the Cayo District where he found that 10 farms had trees planted in lines which also included live fencing with a minimum of 4 trees/ha and maximum of 106 trees/ha. The most important timber species detected were cedar, teak, black poisonwood, dogwood, mahogany and oak. These species provided shade, forage and multiple services but these trees on livestock farms can also generate income by the sale of timber in the market. Thus making this system a good option for small and medium livestock producers in Belize and at the same time it helps to decrease the pressure on primary forests, it contributes to the generation of ecosystem services, generates employment and income, facilitates the sustainability of the current performance of meat and milk production and diversifies production with high value timber (Detlefsen et.al., 2000).

Vidal (2012), also added that Rosa Cruz had determined that the net present value ranged from 14% in small farms to 76% in medium size farms higher than the benefits which was previously calculated (US $3009).

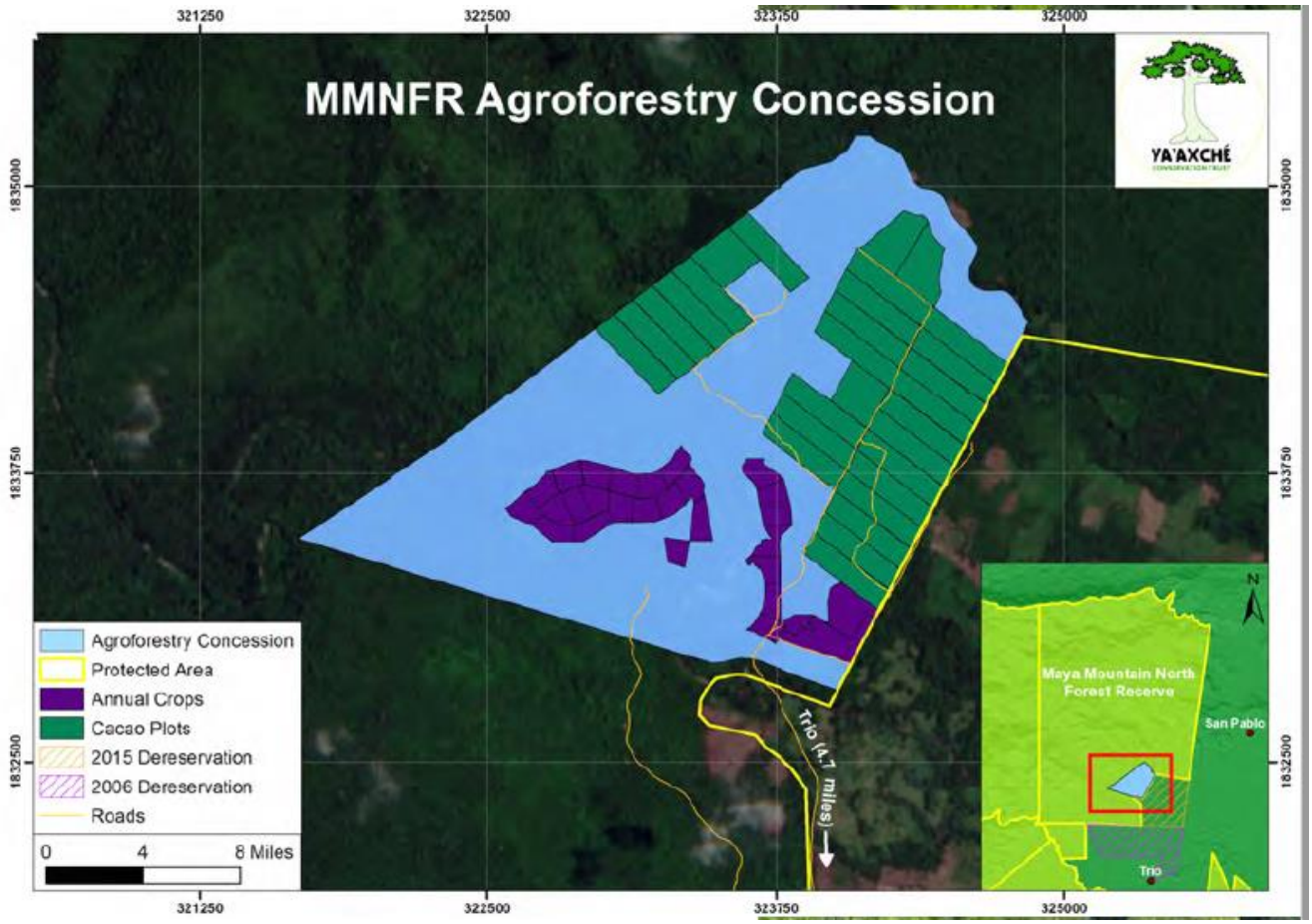
Production of shrub/tree fodder banks in pasture is used for improving cattle production and can be used as supplementary feed, leaves can provide 12 -14% crude protein, 20 - 45% crude fibre and 40 - 83% in vitro dry matter digestibility, depending on plant species, animal type (CATIE/MAF/NARMAP 1996; Pezo. *et.al 1989;* Norton, 1994; Ibrahim *et.al*. 1998), 25% of these are established on total area of pasture. Fodder banks have been established depending on the number of heads, length of dry season, animal type, method of utilization etc. These systems provide improvements of animal production such as increase in milk production yields (Ibrahim *et.al* 1998).

In 2006 the GOB de-reserved 1,189 ha of the Maya Mountain North Forest Reserve (MMNFR), as it had left families landless, forcing them to continue to enter the MMNFR for production to support their families. In 2012, the GOB responded by conducting an eviction causing these families to lose crops, fences and structures. In addition to this, mismanagement of the environment by logging concessioners caused conflict with the local community members. For this reason, in 2015, Ya'axche Conservation Trust along with the Toledo Cacao Growers Association (TCGA) met with the Belize Forest Department to inquire about gaining legal access to MMNFR for an agroforestry concession (Figure 9) to benefit both farmers and their community (Beaton, 2019).

It is important to mention that Forest Reserves are a category of protected areas in Belize. However, in order to hunt, fish, log, extract, camp, conduct agriculture practices and build

permanent structures permits are required because the purpose of the forest reserve is to protect timber stores and conserve soil, watersheds and wildlife (Beaton, 2019).

Figure 9. Maya Mountain North Forest Reserve Agroforestry Concession



Source: Beaton (2019)

This process was successful, and the agroforestry concession was approved through the Forest Rule 23. The implementation phase began in 2015 with a renewable contract that would end in 2029 (a long-term model). The implementation called for two acres (0.8 ha) to be planted per farmer per year until each farmer reached 10 acres (4 ha) total by 2020 (Beaton, 2019).

Ya'axche Conservation Trust emphasize that the goals of the agroforestry concession are:

- Bring sustainable economic development to buffer communities in MMNFR
- Reduce current threats to biodiversity and habitat lost due to illegal and unsustainable agricultural development within the reserve
- Maintain water catchment function and flood regulation function within and outside the reserve

- It is a mutual goal between all partners to assist TCGA in becoming a self-sufficient CBO and concession manager by 2029, then end of their contract's first term.

Somarriba (1998) explains that introducing timber trees as shade in cacao plantation permits farmers to obtain up to Bz$130/harvested tree for *Cedrela odorata.* Timber trees can be managed for minimal negative effects on cacao plants. Cacao plantations offer opportunities for timber production because: i. cacao farms lack adequate shades; ii. the use of shade is not a new practice to local farmers; iii. fast timber growth rate is expected since cacao is grown on sites with good soil and drainage; and iv. farmers organisations have attempted to produce and introduce shade trees in their respective farms and among others.

Review of current permits and procedures for harvesting/transport/trade of timber produced on farms

Procedure for issuing of permit and concessions

The Forest Department is responsible for overseeing the use and protection of the forest, and granting of forest licenses and permits, collection of royalties for forest resources, monitoring, to some extent design and implementation of management plans including the management of half of the country's protected areas through the Ministry of Forestry, Fisheries and Sustainable Development (Forest Department, 2015) now known as the Ministry of Agriculture, Fisheries, Forestry, The Environment, Sustainable Development and Immigration. The Department of Lands and Surveys is another body whose activities and responsibilities also involve the use and administration of forests; this is mainly because they are responsible for the land allocation and distribution.

Within the forest department is a unit known as the Forest Sustainability Services Unit (FSSU), which is responsible for the implementation of the approved policies and legal procedures applicable to the management and use of the forest resources throughout the entire country. These policies and procedures are put into action through several instruments as determined by the Forest Act (Forest Law) which are the Substantive Law (Chapter 213) and Subsidiary Laws of Belize (213s) that governs Belize's Forests. All licenses issued are monitored by the Forest Department and revenues (Royalties) are collected on the materials harvested by all licenses. All Management Plans and Annual Plans of Operation are reviewed by the Sustainable Forest Management Program (SFMP).

It is also important to mention that the Protected Areas are governed by the National Parks Systems Act which falls under the purview of the Protected Areas Program.

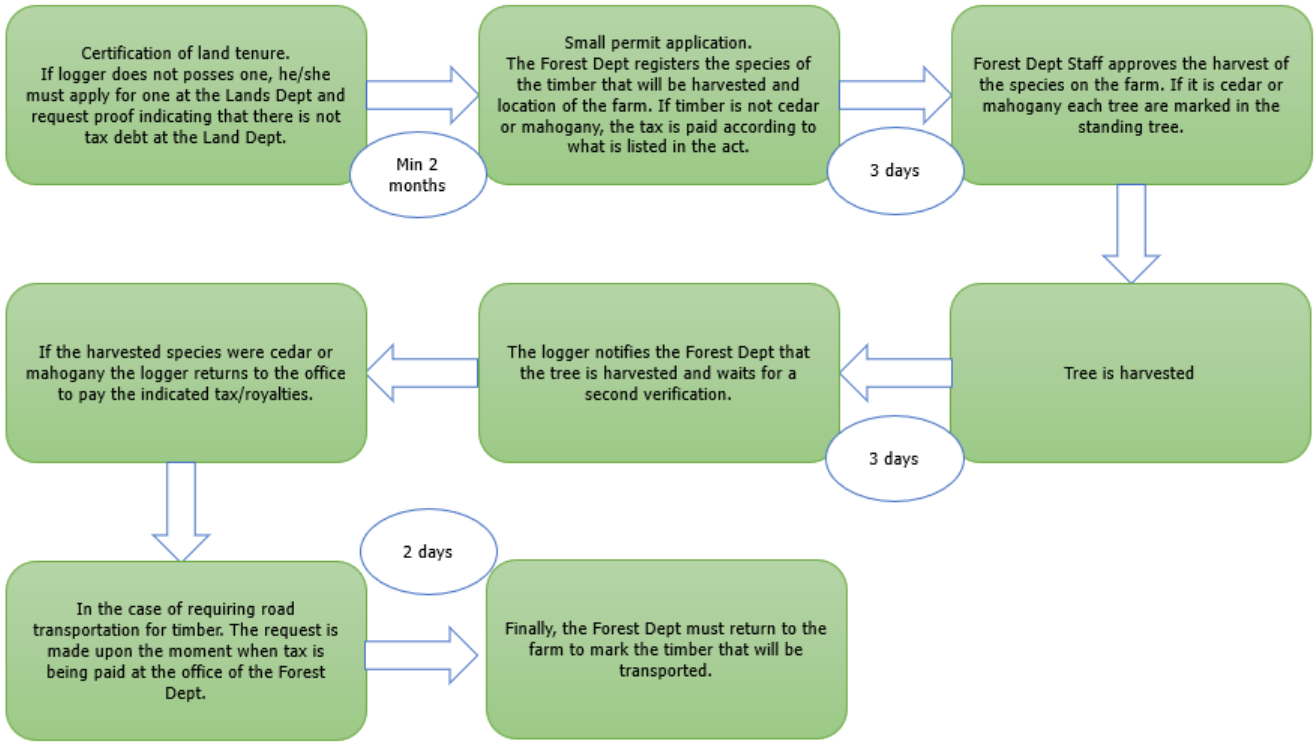
According to the GOB (2016) The Forest Act of Belize established the following categories of licenses and permits which forest resources may be authorized for extraction:

- ***Forest License for Sustained Yield:*** *working of timber or other forest produce, except chicle or crown gum.*
- ***Long Term Forest Licenses (LTFL):*** *this applies to forest in Forest Reserves and community lands, as well as those on private properties. Currently there are eleven LTFL's in forest reserves, three in community lands and seven in private properties. Sustainable Forest Management in Belize is achieved through the long-term planning and use of our forest resources and this is the core of all LTFL. The duration of LTFL's extend from twenty-five to forty years. All LTFL's are guided by a Management Plan that establishes the species and their volumes expected to be harvested for the duration of the license, as well as the methods to be used for the extraction of timber. Each year an Annual Plan of Operation is prepared and submitted to and approved by the Forest Department.*
- ***Forest License not on Sustained Yield:*** *basis for the working of timber or other forest produce, except chicle or corn gum and whether in a timber salvage area or not (Short Term or seasonal Forest License): such a license applies to unprotected national lands, lease land and private properties. The number of seasonal licenses may vary from one year to another since land may be cleared for various purposes; ranging from agriculture to residential development.*
- ***A Petty Permit****: for the working of timber or other forest produce where the royalty value of the produce does not exceed fifty dollars. This type of permit responds primarily to the personal needs of individuals for small amounts of timber or other forest produce such as building materials and farm base uses.*
- ***Community Forest Initiatives****: a few years ago, the Forest Department launched a program with the objective of involving indigenous community in the Toledo District in the management of forest resources in national lands that were being impacted directly by the existence of these communities. Presently, three such communities are beneficiaries of this initiative through which their members have been trained in various aspects of forest management.*

According to Vidal (2012), Detlefsen & Scheelje (2012), in order to apply for a Petty Permit or a license, the logger has to present the land tenure title. If he/she does not possess a land tenure title he/she should request the land tenure title at the Lands Department. Along with the land tenure title, a record of tax payment is mandatory in order to show that there are no debts with the GOB for land taxes. In order to stimulate harvesting in private property, the Forest Department has established a benefit where farmers logging in private land pay half the amount of the royalty (taxes) established by law, as compared to those who harvest in State's land meaning Belize's National Lands. To obtain a petty permit a forest progression or management plan is not needed, and this permit could be granted within a weeks' time allowing

the transaction costs to be very low. The procedures and time required for each stage of the application are described in detail in Figure 10.

Figure 10. Procedure used for timber exploitation from agricultural farm in Belize, by means of small forest permit known as "petty permit"



The Forest Department has shifted from granting short term logging licenses to long term licenses between 20 and 40 years where the licenses are designed to practice sustainable forest management which will enable logging companies to replant timber tress and harvest on a rotation basis (Forest Department, 2015).

Under this initiative a total of 15 long term licenses have been granted to the following: 131,000 ha from private entities, 53,418 ha from national lands in the southern coastal plains and 169,968 ha from licensed forest reserves and other forest reserves. This is approximately 364,217 ha which has been granted long term licenses. In addition, a certification of timber harvesting operation is also another practice of the SFM initiative. The certification can be used as an incentive for logging companies to manage forests sustainably as it allows the companies to transfer some of the costs of sound management to the consumer as well as allowing the consumer to make environmentally responsible choices when it comes to the timber products they purchase. Lastly another initiative is community forestry that aims to get local people more involved in the management of their forests (Forest Department, 2015).

Many demands for logging permits to log a single tree or few trees comes from indigenous and non-indigenous communities where village land are typically not allotted for forestry use. It is

understood that giving autonomy to local government can help to ensure good governance and democratic participation in decision making especially when it concerns sustainable management of natural resources but unfortunately this has not been adequately established and central government still maintains all the power. However, the GOB recognizes the important role that local authorities play in promoting forest development, private and community responsibilities. In other words, the GoB recognizes the need to allocate these responsibilities to town boards and village councils (Forest Department, 2015).

Procedure for harvest, transport and sale of timber

The GoB recognizes that there is a need to engage the commercial private sector because they play a major role in the forest sector, especially in the production and processing of wood products and eco-tourism (Forest Department, 2015).

The Post-Harvest Assessment of Long Terms Forest Licenses have recently been instituted with the objectives of improving Belize's compliance with international obligations such as the Convention on the International Trade of Endangered Species (CITES) of Flora and Fauna. Plants of Belize that are listed under CITES are all orchids, mahogany and rosewood and the trade of these are monitored by this program through an import/export permit system (Government of Belize, 2016).

As part of the forest management plan for forest use the law has a list of species, a minimum size in diameter that can be harvested and taxes/royalties that must be paid either by cubic foot in roll or per tree depending on the species (Detlefsen & Scheelje, 2012).

In the Mennonite communities, they stated that most of the wood sold goes to the construction sector as form boards and less than 1% is used by the furniture industry. In addition, timber for domestic use is mainly for home repairs or houses for the newly married. Lower and Upper Barton Creek and Springfield sells between 70-85% of wood which they harvest. 60% of the form board from Springfield is sold in Belmopan and 80% from Barton Creek is sold in San Ignacio. In order to transport timber from the sawmill gate to the businesses the Mennonites hire a truck to transport timber (Vidal, 2012).

According to reports in 2010, the total income for timber wood sale (soft wood) was Bze$2987 yearly (this income from timber wood may vary from year to year), which is a very low income and these communities are the smallest producers due to the depletion of their forest and little interest in the business (Vidal, 2012).

In the Belize Market the price of sawn timber is stable and has remained that way for the past couple of years. Vidal added that there is a probability that prices are steady since competition is limited, the size of the local market is small and the demand for high quality is low.

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