

Timber production value chain in three Belizean Mennonite communities

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Timber production value chain

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Acronyms and units

Bft: Board foot
BZ\$: Belize dollars
CBA: Central Building Authority
FD: Forest Department
LBC: Lower Barton Creek
PP: Petty Permits
SIB: Statistical Institute of Belize
SPS: Silvopastoral system
UBC: Upper Barton Creek
US\$: US dollars

Conversion factors

1m³ = 220 Bft
1 m³ = 35.34 ft³
1 ft³ = 12 Bft
US\$ 1 = BZ\$ 2

Stakeholders consulted

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Belmopan City Council: Mr. Robinson (records)
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The Wood Depot: Emile Mena, Forest Drive Belmopan.
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Chaha Creek Lumber Yard

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- Abraham Martin: Lower Barton Creek
- Isaac Friesen: Lower Barton Creek
- Francisco Velasquez: Springfield
- Omar Velasquez: Springfield

Introduction

Conversion of primary forests to pastures is widespread in Central and Latin America. The progressive removal of trees has resulted in environmental degradation and a decline in productivity, simultaneously threatening rural livelihoods and regional biodiversity. As a result, some agroforestry practices are being developed in Central America in order to reduce the pressure on the forests, and provide an alternative source of timber especially for small scale farmers. However, these practices are not yet widely implemented in all Central American countries, as some of them are still harvesting the forest as their main source of timber.

Timber extraction in Belize began in the early 1920's with the selective logging of elite species such as cedar (*Cedrela odorata*) and mahogany (*Swietenia macrophylla*). This type of logging was certainly not intended to be sustainable as the emphasis was exploitation (FAO 2005). It continued for well over seventy years; at the beginning of that period, logging operations represented about 80% of total product exports, but by 1963 represented only 15% of exports and since then this value has continued to decline due to

increased agricultural activity based on products for export, such as sugar cane, citrus, mango, papaya, bananas and cocoa (Sabido 2007).

Among many timber producers in Belize, Mennonite farmers have been actively working in this area for a long time. Mennonite farmers not only process lumber for trade but also for household use. In fact, most of the lumber they use is for building their homes, furniture and fuelwood for cooking. In order to understand their productive value chain and contribute to other Belizean communities with available information based on local experiences, this study aims to systematize Mennonite's timber supply chain as well as analyze constraints and opportunities to strengthen the value chain system. Due to the fact that this is a particular group with very strict religious practices, all the considerations and recommendations in terms of the analysis are carried out with respect for their religious beliefs.

The study covered three Mennonite communities: Upper Barton Creek, Lower Barton Creek and Springfield, all of them located in Cayo District. With the lessons learned, suggestions for

improving the production process will be given. It is also expected that the study will provide an incentive to other communities for timber production in agroforestry systems.

In order to assess and systematize the experience, the following procedure was observed:

- After approval of the consultancy work plan, a meeting with key contacts of the three communities was held in order to introduce the work and explain the reason for doing so.
- A literature review in forestry and silvopastoral systems as well as methods to develop value chain studies and collection of information about the history of the Mennonites in Belize were carried out.

- Field visits and semi-structured interviews to key contacts were conducted in the three communities to see the current situation and prospects of the whole chain, logging, sawmill (primary transformation), carpentry (secondary transformation), market and trade and how they get customers.
- After field visits, the supply chain was mapped and validated with key informants to gather feedback from them.
- Consultation with stakeholders: other timber manufacturers and traders, clients, Forest Department, Ministry of Agriculture, and landowners nearby the communities were interviewed.
- All the information gathered was systematized and analyzed to produce this written report.

Socioeconomic context in the studied communities

Belize is the second smallest country in Central America with an area of 22,963 km² and 303,422 inhabitants. The Belizean population is ethnically diverse, with a majority of multiracial descendants from Mestizo, Creole, Maya, Garifuna and Mennonite. The Mestizos are the largest group, with its share of the total population edging up to 50%, Creole accounts for 25%, Maya and Garifuna make up 10% and 4.6% respectively, while Mennonite population represents 3.5% (SIB 2010).

Mennonites are the most conspicuous population in Belize; they hold fast to the country culture and also assist in commerce, carpentry, engineering and agriculture throughout the country. The Mennonites emerged during the radical Reformation on the 16th century in Northern Europe. They were persecuted throughout the ages for their beliefs, particularly their refusal to pay land taxes and to support the military. This group migrated from Holland to Germany and then to America. For more than 400 years, they have spoken a dialect which is an amalgamation of German and Dutch, and it is still spoken in the Mennonites communities of Belize (BNLSIS

2008). They are migratory, looking for good conditions to live and work the land.

There are two types of Mennonites very well differentiated in Belize: The progressive and the conservative. The progressive Mennonites are more modern and open to new technologies. They provide many services and products to the country. They are located in Spanish Lookout, Cayo District and in Blue Creek, Orange Walk District. The conservative Mennonites follow a very strict discipline based on their religious beliefs. They believe that modern ways of living contaminate their faith, thus they try to isolate themselves from the rest of the population. These communities still refrain from using modern farm equipment not because it is evil but because it may harm Nature. The communities selected for this study belong to the second group. In this sense, a couple of factors limited the scope of the consultancy:

- No electricity in the operation process, just animal or human traction.
- Timber production is more important for subsistence than income generation; the latter is considered a secondary activity.

Silvopastoral practices

Silvopastoral systems (SPS) have not been widely adopted in Belize because of constraints related to risk, capital, markets and poor genetic stock (Alonzo and Ibrahim 2001). Farmers are reluctant to change from traditional to new technologies mainly due to lack of knowledge (Aldy et ál. 1998). Besides, the concept of SPS in Belize is totally different from other Central American countries as long as the forest cover represents about 61% of the country (FAO 2010), so farmers don't see the need to plant trees or conserve them in their farms¹.

There is, however, a couple of SPS suitable for Mennonite farming systems. *Windbreaks in pastures* reduce wind velocity, provide shelter to cattle, reduce pasture desiccation, and prevent wind soil erosion. While the primary function of the windbreaks is agronomic, they may also play an important ecological role as habitat and resource providers for animals and plants. Windbreaks may also form natural corridors for animals to cross the agricultural landscape (Harvey et ál. 1999).

Another common SPS that appears to hold considerable potential for Mennonite farming is

a system of *isolated trees within p es*. In most pastures in Central America, some canopy trees and shrubs are usually left standing to provide shade for cattle (Guevara et ál. 1992). This is very much the situation in Upper Barton Creek, where some valuable timber trees are left in the fields. These scattered, isolated trees may be relics of the former forest, or otherwise, may have been planted or regenerated since the pastures were established. In addition to serving as sources of fodder, fruit, timber, fuelwood, and shade for livestock, these isolated trees also provide habitat for biodiversity within the agricultural landscape (Guevara et ál. 1998, Harvey et ál. 1999) and may help promote landscape connectivity for some species.

Timber profitability

The combination of trees for timber production with livestock may provide a steady income over the medium term, increasing the economic conditions of a farm or household through diversification of products. In the same way, the hedges are profitable for farmers to the extent that they provide replacement stakes (Trujillo 2009). In Cayo District, Alonzo (2000) found that lumber harvested from SPS could generate benefits up to US\$3009, value calculated for 50 standing

¹ Sabido, W. May, 2011. Chief Forest Officer, Forest Department. Personal communication.

trees per acre after 40 years. It might not seem like a substantial amount after such a long period; however, since the density of trees was low, it did not require much management or planting investment. On the other hand, if both the prices of lumber and the density of trees were higher, this alternative would be more profitable than projected by the study (Ibrahim et al. 2000).

Ten years later, Rosa Cruz (2010) studied the profitability of farms in Cayo District comparing scenarios with and without SPS projects. It was found that the net present value of all the farms including a timber component showed a considerable increase that ranged from 14.01% in small farms to 75.59% in medium size farms. These results demonstrated that there was economic potential in timber activities within SPS farms.

Legal requirements for logging in Belize

When Belize was a British colony, great forest concessions were granted to private enterprises. Those concessions were typically bounded by rivers in an area of 4.82 km (2.99 miles), under the criterion that the size of the grant would be suitable for the sustainable management of the forest offering economies of scale. After some years, this concept disappeared due to political and economical interests; concessions were reduced to

small pieces of forest without any control on the resource administration and management (FAO 2004). Nowadays, most of the forest remains the State's property, and harvesting is carried out by logging permits granted by the government. Through a management plan, the Forest Department verifies the capacity of the logger to harvest timber and the capacity of the forest to supply the expected timber production (Rosa Cruz 2010).

According to the Forest Subsidiary Law revised in 2003 there are the following types of licenses and permits:

- A forest license for sustained yields of timber or other forest products
- A forest license not on a sustained yield basis of timber or other forest products
- A forest permit for timber extraction or other forest products, in a timber salvage area where the royalty value of the product does not exceed one thousand Belizean dollars (US\$500)
- A petty permit (PP) for timber extraction or other forest products, where the royalty value of the produce does not exceed fifty dollars (US\$25)
- A chicle (*Manilkara zapota*) license.

In order to apply for a PP or a license, the logger has to present the land tenure title. If he does not have this document, he should request it at the Lands Department; that process could take from 2 to 3 months. Along with the land tenure title,

a record of tax payment is mandatory. To stimulate the harvesting in private property, FD has established a benefit: farmers logging in private lands rather than in the State's land pay half the amount of the royalty established by law; in other words, if the royalty for mahogany is BZ\$ 1.24/

Bft, the timber from private property will pay BZ\$ 0.62/Bft. To obtain a petty permit, neither a management plan nor a forest professional is required. This permit could be granted within a week; therefore transaction costs are very low for small sized producers.

The productive value chain

Basic concepts

A chain describes the full range of activities which are required to bring a product or service from its conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumer, and final disposal after use (Kaplinsky and Morris 2002). There are two types of chains from a business perspective: the supply chain and the value chain. The supply chain management emerged in the 1980's as a new, integrative philosophy to manage the total flow of goods from suppliers to the ultimate user, and evolved to consider a broad integration of business processes along the chain of supply (Supply-Chain Council 2005). Supply chain is a term *“now commonly used internationally to encompass every effort involved in producing and delivering a final product or service, from the supplier's supplier to the customer's customer”* (Feller et al. 2006).

On the other hand, in a value chain, actors recognize the close interdependence between each other, share a common short and long term vision, and therefore are willing to work together sharing information, risks and benefits. Under this context, they can be more competitive creating a win-win situation (Gottret 2009). Each link in the chain of activities gives the product more value added which can be seen as the difference between expenses to produce and the sales price of the product (Sathre and Gustavsson 2009).

For James and Jones (2003), the value chain is focused on the customer's perspective. The primary focus in value chains is on the benefits that accrue to customers, the interdependent processes that generate value, and the resulting demand and funds flows that are created (Feller et al. 2006). Supply chains focus upstream on integrating supplier and producer processes, improving efficiency and reducing waste, while value chains focus downstream, on creating value in the eyes of the customer (Feller et al. 2006).

Tools and methods to assess a value chain

There are many tools and methods to assess a value chain. The most common and useful methods are the following.

Characterization of the business organization

The products and/or services offered by the organization in order to generate income are firstly described and assessed the market segments or customers these products or services are addressed to. This information can be obtained from various sources, starting with the senior staff and managers of the organization, and supplemented by secondary information from surveys or studies already completed and interviews with key players (Gottret 2009).

Value chain mapping

The chain map is a visual representation of the actors who perform the various activities that

add value to a commodity and the relationships between these actors, since the beginning of the productive process to the final consumer. The chain map allows viewing the number of stages by which a product goes through from the supply of inputs, to production, postharvest management or processing, marketing, up to the final consumer (Donovan 2006, Gottret 2009). A value chain map may be focused on the product handlers or otherwise include service providers participating in the chain.

Semi-structured interviews

Semi-structured interviews are non-standardized and are frequently used in qualitative analysis when a specific hypothesis is not to be tested (David and Sutton 2004). The researcher has a list of key topics, issues, or questions to be analyzed. In this type of interview, the order of the questions can be changed depending on the direction of the interview. An interview guide can also be used, and additional, explanatory questions can be asked (Corbetta 2003).

Development of the timber value chain in the Mennonite communities

Historical overview

Mennonites arrived to Belize in 1959, and relocated along the Rio Hondo River. They signed a special agreement with the Government of Belize which exempted them from military service and certain forms of taxation while guaranteeing them the right to practice their religion and farming practices within their closed communities. They also have their own form of local government and run their own schools.

The three communities within the scope of this study considered timber as a primary income activity at the beginning of their colonization, but nowadays it provides an additional income. Their main economic activities, presently, are cattle farming and agriculture. Sustainable forest management and/or enriching are not considered of importance for the household economy.

Upper Barton Creek

This community was settled by Mennonite reformers in 1969 on the hills of western Belize. Settlers were mainly German families with very

strong convictions against modernity, who had originally established in Spanish Lookout and Shipyard. In their venture, they were joined by some Mennonites from Pennsylvania. The land they colonized was very hilly and rocky, and covered with forests. Agricultural fields were established on the less steep areas, and the clearing of the forest provided them with lumber for building houses and furniture.

Their main economic activities were agriculture (vegetables) and honey. They farmed on a small scale using horses, and some cattle farming was done, but on a very small scale and mostly for home provision (meat and milk products). Surplus of products (crops and cattle) was sold at the markets in the nearby towns (Santos 2011). By 1988, the total population was 157, including 45 church members and two ministers (Friesen 1989). These people lived simple lives. They did not own any equipment with motors nor did they use electricity. Nonetheless, the colony was more self-sufficient than many others.

The community grew to 35 families but many of them decided to migrate to Springfield, their young sister community, due to the difficulties in finding water and poor soil conditions for farming.

Today only 23 families (around 180 persons) live in Upper Barton Creek. About 50% of the original forests remain because of the topography; but, for the same reason, they are not productive forests. No efforts have been done neither to enrich the forest nor to manage this resource.

In the community, there is a sawmill owned by a resident; it was established one year after the community was settled.

Lower Barton Creek

This community was settled one year after Upper Barton Creek. Although both settlements have similar ways of living, their understanding of the Bible as well as some rituals are different. The settlers purchased 1,500 acres of land, and cleared about 100 acres to develop their farming crops.

The terrain is flatter than that of Upper Barton Creek. Their main economic activities are agriculture and cattle ranching with Holstein, Guernsey, Jersey and Brown Swiss breeds. Some farmers are also engaged in pig farming (Santos 2011).

Timber production was not a very important activity at the beginning. It was more for household

needs than for trade, but around 1975 it became one of the main income generating activities due to the clearing of land for cattle ranching and good timber prices. In spite of that, only one sawmill was established in the community. According to the people interviewed, around 90% of their forests have been cleared out and most of the timber now used comes from outside sources.

Springfield

This town is located to the south of Belmopan. It was created in 1996 by former residents of Upper Barton Creek and Mennonite immigrants that came from Paraguay and Bolivia looking for an isolated and quiet place to live under their religious beliefs.

The settlers bought around 1200 acres of land from Mr. David Hayles, a large land owner. Mr. Hayles allowed them to log his forest lands next to the community property for more than ten years. The loggers used to pay him an overhead of 20 cents per foot of softwood woods and 30 cents per foot of mahogany and cedar. The logging activity acquired importance due to the rich stock of high quality woods. In fact, logging activities and timber production were so intense that people from Upper Barton Creek spent some time a year in Springfield to help. It was the first income generating activity for the community. A sawmill was established on the main road of the community, but it could not cope with the production so a second one was built.

Today, the community also has a carpentry workshop where rustic furniture is produced. Most of the production is used to satisfy household needs.

Present situation

In this section, the current situation and perspectives of each of the Timber Value Chain links is described. Due to the similarities in all the stages among the three communities, a general description is offered with brief mention

of the few differences among them. The value chain map (Figure 1) demonstrates that timber processing holds a very simple structure in the Belizean Mennonite communities. The distribution channels are represented in the figure by arrows showing the different destinations. The percentages correspond to the portion of the total production for each destination. The prices are illustrative for form board which is commonly made of quam wood (softwood), due to the highest importance of this product for these communities.

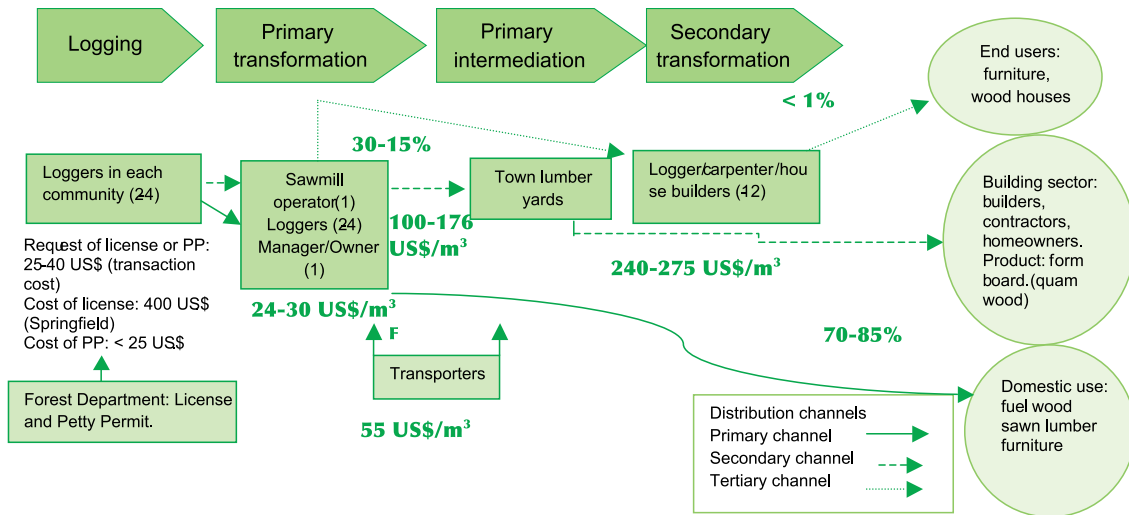


Figure 1. Timber value chain map in the three Mennonite communities evaluated

Logging

This stage considers all the activities related to timber harvesting, including the selection of species in the forest or in a SPS, logging, and transportation to sawmill or carpentry.

In the three communities, the forest is the main source of lumber. In Upper Barton Creek, there are some initiatives of silvopastoral practices but they do not supply the demand due to the limited management practices and the low density of trees. The main species processed by the sawmill are quam wood (*Schizolobium parahyba*), santamaría (*Calophyllum antillanum*), sapodilla (*Manilkara zapota*), bullet tree (*Bucida buceras*) and ceiba or cotton tree (*Ceiba pentandra*)².

According to Rosa Cruz (2010), the main species in SPS are: cedar (*Cedrela odorata*), mahogany (*Swietenia macrophylla*), teak (*Tectona grandis*), black poisonwood (*Metopium brownei*) and mayflower (*Tabebuia rosea*). Evidently, this set of SPS species does not coincide with the one mentioned by the sawmill owners and administrators interviewed. This demonstrates that the forest is still the main source for timber in the region.

In Springfield the interviewed expressed that scattered trees on pastures are still too young to contribute to timber supply. The main species

processed by sawmills in this community are prickly yellow (*Zanthoxylum* spp.), quam wood, ceiba and, in very seldom, mahogany. Finally, in Lower Barton Creek there are more SPS than in Springfield, residents stated that 50% of the timber production is supplied from this source. They expressed that timber activities have decreased during the last two years because their forests are becoming depleted, as around 90% of their forest stock has been used up. Their only alternative is trees in pastures or national forests. In any case, supply is not enough to meet demand.

The timber volumes harvested by the three communities from 2008 to 2011 is shown in Table 1. Data from Springfield were provided by the Forest Department. Volume data from UBC and LBC were not available because these communities operate under PP, which records the number of trees, not the volume. A gross estimation of the volume of extraction was made with each BC sawmiller based on their output records (volume processed). According to the records provided by both the interviewed and FD, the volume has dropped considerably these last four years. This might be due to the shortage of raw material, since logging actions are not controlled, and forests do not receive any treatment after logging; in fact, there is not a sustainable lumber production system in place.

¹ Penner, D. May, 2011. Sawmiller in Lower Barton Creek. Personal communication.

Nowadays, the three communities work on a timber-order basis. That is to say, a customer asks for a specific amount of a desired species -mainly quam wood, prickly yellow, or cotton tree. The loggers explore the forest and, once they have identified the site, they cut as many trees as they need to satisfy the demand.

In UBC and LBC, the costs for the logging operations comprise that of the PP and the overhead paid to the land owner. In the case of these two communities, the only requirement to obtain a PP is an authorization letter from the landlord giving his permission to log in his property. PPs are paid

by royalty rates with two payments alternatives per tree or per cubic foot (Table 2). The cost of a PP should not exceed 25 US\$.

Table 1. Volume of timber (m³) harvested by the three Mennonite communities evaluated (2008 to 2011)

Community	2008	2009	2010	2011
LBC	NDA*	515.58	226.91	102.35
UBC	NDA	NDA	457.10	116.40
Springfield	216.47	315.38	231.46	NDA

*NDA: No data available.

Table 2. Royalties for the most common commercial species used by the three Mennonite communities evaluated

Species	Tax per tree (BZ\$)	Alternative rate per ft ³ (barkless volume) BZ\$
<i>Swietenia macrophylla</i> (mahogany)	-	1.24
<i>Cedrela odorata</i> (cedar)	-	1.24
<i>Calophyllum antillanum</i> (santamaría)	14	0.28
<i>Vochysia hondurensis</i> (yemeri)	16	0.24
<i>Manilkara zapota</i> (sapodilla)	16	0.30
<i>Bucida buceras</i> (bullet tree)	16	0.30
<i>Ceiba pentandra</i> (cotton tree)	8	0.12
<i>Schizolobium parahyba</i> (quam wood)	8	0.12
<i>Zanthoxylum</i> spp. (prickly yellow)	8	0.12

Source: Forest Act, Chapter 213, Subsidiary Law Revised Edition, 2003.

In UBC and LBC, every logger must get his own PP with FD. The royalty tax is half the price because it is private property. Rosa Cruz (2010) estimated that the transaction costs to request a permit were between US\$25 and US\$40 considering the time spent and transportation expenses.

In Springfield, they have a common license renewable every eight months that allows them to log within their property. They pay US\$400, whereby US\$250 is the cost of the license and US\$150 is the administration cost. The first amount is the credit to log any allowed species in the season. When this amount is exceeded, they pay for the volumes harvested thereafter. A person in the community is the responsible for the license. In the sawmill, a tax is charged to the loggers when they process their lumber: 1 cent ft⁻¹ for softwoods and 5 cents-1 for mahogany and cedar. According to the sawmill administrator, they keep such an open and honest relationship with the FD, that this institution controls the amount of lumber cut by checking their milling inventory.

In UBC and Springfield, the logger is the only actor. In general, he controls the complete timber value chain, from the forest to the sales point. In the case of LBC, the situation is different: loggers deliver their logs to the sawmill and, from there on, it is the sawmiller who controls the timber up to the point of sales. In the three cases, the logger works in partnership with another resident.

The cutting is made using a “two-man saw”; it takes about 3-5 minutes to fell a tree, depending on the type of timber (softwood or hardwood). According to field observations, they know how to use the directional felling method, even though there is a large amount of waste as the stumps are too high (Photos 1&2). The type of saw used makes it difficult to cut in the most appropriate way.

To skid and upload the logs, each logger provides a pair of oxen or horses: one pair transports timber from the felling point to the log collecting point, while the other one is used to carry logs on a cart out of the forest. It takes one year to train these animals for logging operations. The cost of the oxen is around US\$3500/pair while the cart is about US\$1500.

Logging operations in the three communities are very-low intensive due to the small amount of wood extracted. This fact, along with the use of animal traction methods, produces a low impact on the soil and vegetation. The critical point in this moment is the scarcity of raw material in the lands belonging to the three communities. There is not enough lumber neither in the forest nor in the farms to supply the production system. The interviewed expressed concern about this issue and now they are open to the implementation of strategies that guarantee the sustainable timber production.



Photo 1. Oxen and carts are the indispensable tools for transporting logs from the forest to the sawmill

Primary transformation

This stage starts when the logs arrive to the sawmill to be transformed into sawn wood. The sawmill is run by horses (Photos 3 & 4). One person (a sawmiller) is in charge of the milling operation and another one guides the horses in a circular pattern to generate the energy that makes the saw work. This person is normally the logger who brings his own horses to work. If the logger doesn't own horses, they are rented. Some residents stated that horses are so valuable that people trade them for commodities.

The volume of wood processed by these communities from 2008 to 2011 was estimated by the three sawmillers (Table 3). Calculations were based on the annual records that each sawmill keeps. In Springfield, for 2008 they reported a volume higher than that registered by FD for extraction in that year. This difference might be due to previous outside logging on Mr. Hayles' land, which was not reported in their license.



Photo 2. Stump of a recently harvested tree. It is evident the waste of wood because of the high cut

According to their experiences, the volume of timber for domestic use is larger than that sold out (Figure 2). Most of the wood sold goes to the construction sector as form board; less than 1% is used by the furniture industry. On the other hand, timber for domestic use is mainly for home repairs or houses for the newly-married; less than 10% is used to furnish the house.

Table 3. Volume of sawn lumber (m³) produced by the three Mennonite communities evaluated (2008-2011)

Community	2008	2009	2010	2011
LBC	NDA*	343.72	151.27	68.23
UBC	NDA	NDA	304.73	77.60
Springfield	847.92	283.84	208.31	NDA

*NDA: No data available.

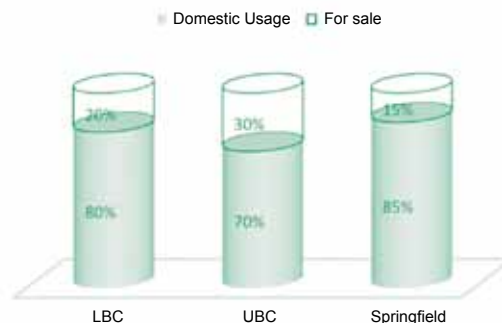


Figure 2. Destination of the lumber production from the Mennonite communities studied



Photo 3. Primary transformation: sawmill machinery form Upper Barton Creek

Sawmill production costs.- Table 4 shows the total cost of primary transformation in the sawmills of the three Mennonite communities evaluated. The total cost is calculated at the farm gate (the most common method of trade). Farm gate prices do not consider any separately billed transport or delivery charge (OECD 2004). The sawmiller is the main actor who is in charge of all the sawmill operations. In Springfield and UBC, the sawmiller is just a service provider while in LBC he is a key player for trade.

In UBC, when the logs arrive to the sawmill the responsible of operations takes charge of all the lumber received. He records the species and dimensions of each log; according to these data a cutting fee is established. Because the sawmill is private, all the costs for sawmilling go to the owner. He pays US\$50 a day to the saw cutter and maintains his sawmill on a need basis. The total income generated by the sawmill in 2010 was US\$7000 and the maintenance cost was around US\$2000, while the saw cutter wages represented almost the remaining US\$5000.



Photo 4. Primary transformation: The sawmill is run by horses

LBC has a community sawmill. The operational system is different due to the fact that all the loggers deliver their logs to the saw miller and he takes charge of processing and trading. He contributes with two horses, while his assistant and the logger contribute with two and four horses respectively. The incomes generated are shared among all the actors of the chain. In 2010, total production cost was estimated in US\$ 4493.

In Springfield the sawmill is also communitarian, and two fees are charged for using it. The first one pays for the operator and the license. The second one (US\$3/ 3 hours of usage) goes to a common fund. When an inhabitant processes wood for household needs, he doesn't have to pay any fees. According to the Springfield residents, in 2010 they spent about US\$2000 in maintenance. The sawmill manager reported that the volume processed was 208.3 m³; hence the total production cost was approximately US\$ 5041.

Table 4. Sawmill production costs (US\$ m⁻³) for the three Mennonite communities evaluated

	Hardwood	Softwood	Harder wood
Upper Barton Creek			
Sawmill fee	27.50	22.00	33.00
Eight horses	3.85	3.08	3.85
Total cost at farm gate	31.35	25.08	36.85
Lower Barton Creek			
Sawmill fee	41.80	22.00	
Eight horses	11.04	7.70	
Total cost at farm gate	52.84	29.70	
Springfield			
Sawmill fee	24.20	19.80	
Contribution fee	2.20	1.10	
Eight horses	11.00	3.30	
Total cost at farm gate	37.40	24.20	

Sawmill machinery and equipment.- Because the communities don't use electricity, their production systems are not adequate to produce high quality products. There is a primitive way of working with outdated technology. Even though,

this is not a critical point for them as their target market does not demand high quality. They don't sell dry sawn lumber nor they store it; all the production is sold immediately or within the week.

The sawmill operators do not have safety protection equipment. They have had accidents in the past, though in one of the sawmills evaluated the saw was encased in a wooden case. However, this protection is not enough to prevent accidents and potential risk to health and life.

In the three communities the processing capacity is about the same: 200 Bft/hr for softwood and 133Bft/hr for hardwood. These figures show the low capacity of their sawmilling system and evidence a comparative disadvantage for competitiveness.

Sawmill waste.- Despite the people interviewed understand the concept of 'yield', they do not estimate it because they don't consider they have waste as everything is used in the farm system. It is very important to consider this point to track the efficiency of the operation but this issue is not a key point from the local perspective.

All the waste of milling is used as fuelwood, and the saw dusts are used as weed control for the crops. Fuelwood is the unique source of energy for cooking and heating their homes; in consequence, none of it is sold. The increasing scarcity

of wood is beginning to pose a problem to dwellers in relation to firewood supply. One of the farmers mentioned: *“I totally regret having cut out my mountain, now I see how important the forest is for our family”*.

Charcoal was produced and sold in Springfield about three years ago. However, the producer became sick and decided to stop due to the risk to his family’s health. In the other two communities they didn’t express any intention to produce charcoal due to the experience faced in Springfield and the limited market for this product in San Ignacio.

Intermediation trade

This stage embraces from the sale at the farm gate to the final user. The intermediary is the one who deals with final customers; among intermediaries are lumber yards and furniture shops. In Belmopan, two lumber yards -Ayala’s Lumber Yard and Builders Hardware- are clients of Springfield sawmill. In San Ignacio, the lumber yard Chaha Creek and two small furniture stores buy from BC sawmills. According to the interviewed, around 60% of the form board processed in Springfield is sold in Belmopan, and 80% of the same product from BC goes to the wholesaler in San Ignacio. The rest is for retailers that arrive to the communities to buy for themselves.

Mennonites hire a truck to transport timber from the sawmill gate to the businesses. Every delivery

is at least 5000 Bf. Builders Hardware’s manager expressed that they receive around three deliveries per month, while Ayala’s Lumber Yard doesn’t buy very frequently from the Mennonites; in fact, less than 1 % of their merchandise comes from this source.

Representatives from San Ignacio businesses agreed that Mennonite lumber from BC is more expensive than that from other Mennonite communities in Orange Walk Town. The same product is selling at 5% less than BC communities.

Secondary transformation

Springfield is the only community that reaches this stage of transformation in the form of furniture and wooden houses. Nonetheless, demand for their products is very sporadic and several months they don’t receive any order. The carpentry workshop is communitarian, so each one may build furniture by himself there.

There is also a craftsman who makes rustic furniture for sale (Photo 5); he has his own carpentry workshop at home and harvests wood to meet his demands. The most demanded species are mahogany, cedar, salmwood (*Cordia alliodora*), nargusta (*Terminalia amazonia*), santamaría, prickly yellow, quam wood, red and white tamarind (*Acacia* and *Pithecellobium* sp.). After logging, he takes logs to the community sawmill to be processed; he has to pay a fixed fee of 20 cents per foot. The sawn



Photo 5. Rustic furniture for sale

lumber is dried for about three months and then he makes the furniture according to the specifications received. He produces different kinds and designs of furniture; time spent on each piece depends on how elaborated it is. In some cases when the order is not large and the client wants it in a short time, he buys sawn lumber, mainly mahogany, at a cost of US\$ 2.50/ Bft, from a large lumber provider such as Yalbac Lumber. In his workshop, he has the instruments and tools necessary to create rustic furniture; among them, a planer, a band saw, a plate sander bold, a belt sander and a lathe.

All these tools operate under horse traction. Due to the lack of electricity and sophisticated tools, the furniture produced is not well finished.

Two other Springfield residents recently started a new business: the building of wooden mobile houses (Photo 6). One of them expressed that since he does not have much land to farm, he had to find other options and decided to build these houses for sale. The size of a mobile house varies according to the client's needs; a 240 ft² house, for example, costs US\$ 1900, considering only the



Photo 6. Wooden mobile house for sale in Springfield

materials used to build it -labor is not considered- (Table 5). Labor is mainly familiar, therefore, it is not easy to estimate the time per person to finish a product. Residents interviewed suggested that one person working alone could finish a house in about seven working days. According to minimum wages for farm workers reported by Labor Department³, a day work is worth 10 US\$. Then, the total cost of a house, including labor, would rise to US\$ 1970 (US\$ 1030 net income).

³ William, I. May, 2011. Belize Labour Department. Personal communication.

Table 5. Construction materials used to build a mobile house

Item	Quantity (Bft)	Unit Cost (US\$/Bft)	Total cost (US\$)
Lumber	2000	0.8	1600
Steel	NDA	NDA	300
Total cost			1900

*NDA: No data available

This is another value added product that could have potential acceptance in the market. Nonetheless, neither furniture nor other wood items they are able to produce receive any marketing, because they don't see much opportunity in these businesses. They do not have an idea on the current demand for their products.

Trade and income

In the three communities there is no method for pricing. With furniture, for example, in price fixation they only consider effort and time spent, besides the cost of inputs. They follow the market prices to make decisions about their products.

In UBC and Springfield, the commercialization is made by the owner of the logs -identified as 'the logger' in the productive value chain. There are no more than four loggers in Springfield and they have their own contacts. They are very popular in Belmopan for construction timber. The traditional

way of trade is at farm gate, so they can sell their product at low prices (Table 6).

In LBC, trade is made by the sawmiller who shares the benefits with the loggers and assistants. Softwoods generate the highest income; however, individual profit is not significant because timber processing involves many actors. According to the volume reported for 2010, the total income from sold products (softwood) was US\$ 2987, which represented a very little individual income. This community is the smallest producer due to the depletion of their forest and little interest in the business.

UBC gets its highest income with hardwood processing, but the volumes handled are not significant due to the low demand and scarcity of these species. Based on the total income from softwoods (US\$ 8447), the net income from trade (sale outside the community) was estimated as 30% of that amount. This represents a good income; though it is not steady from year to year,

Table 6. Sawn lumber incomes and prices (US\$ m⁻³) in the three communities studied

Community	Hardwood price	Hardwood income	Softwood price	Softwood income
Upper Barton Creek	297.00	157.30	176.00	92.40
Lower Barton Creek	137.50	137.12	99.00	98.72
Springfield	165.00	127.60	110.00	85.80

as it depends very much on the demand and the availability of wood.

In Springfield, loggers' incomes are not as high as in the other communities. Although for using the sawmill facilities, each user has to pay a contribution fee for the community fund, which could also be counted as an income. The money collected is used to support community activities and solve common problems; in 2010 about US\$ 2000 were collected. According to their production records, their total net income for sawn lumber was US\$ 2681, which, for them is not significant. The only evidence of marketing found in Springfield is a simple wood sign on the road at the community entrance (Photo 7).

The demand for furniture and wooden houses is very low in these communities. It might be due to both the absence of marketing and the competition of small stores in town with a more specialized offer. The carpenter and builders have their own clients -most of them from out of town. Furniture prices vary with the design and size, the

species used and time spent. Table 7 shows the prices for the most commonly sold products.

Markets: supply and demand

The timber market in Belize is very small compared to the rest of Central American countries. There are few large companies throughout the country that govern the timber market. According to FD cited by FAO (2005), in 2002 there were 45 sawmills in Belize with an established annual capacity of 200,000 m³ (Figure 3). According to the statistics of the FD, the national forest industry processed 60,145 m³ in 1999, of which only 39% came from legal forest concessions. Three sawmills processed around 18 percent of that amount. Another ten sawmills produced at 30%, with an installed capacity of 3000 m³ per year, and the remaining 52% were concentrated in 32 sawmills with an installed capacity ranging from 500 to 2000 m³ yearly (FAO 2005). It is important to highlight the large portion of “not milling” illustrated in Figure 3, which means that the industry processed less than half of the total timber production.

The distribution of the main types of timber produced in Belize is illustrated in Figure 4. According to the last Agriculture Assessment (1987-2007), pine and mahogany still represent the most important timber products both for export and domestic use (Castellanos 2009).

Table 7. Prices of wooden products sold in Springfield

Products	Price (US\$)
Chair (rustic)	30.00
Chair (fancy)	50.00
Table	112.50
Bed	55.00
Wooden mobile house	3000.00



Photo 7. Public portrayal at the main entrance of Springfield

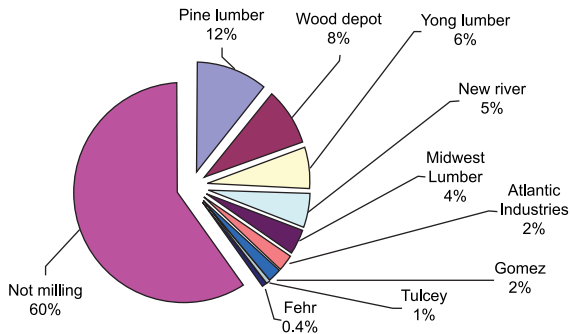


Figure 3. Installed capacity of main sawmills in Belize
Source: FAO (2004).

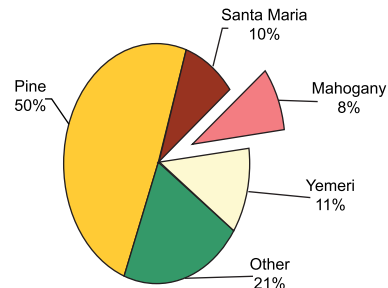


Figure 4. Distribution of timber production at national level in 2004
Source: FAO (2005)

At the local level, in Cayo District there are two areas where the timber trade is concentrated: Belmopan and San Ignacio. In Belmopan, the country's capital city, there are two timber dealers: Ayala's Lumber Yard and Builder's Hardware and one large pine company: The Wood Depot. All of them were consulted on the current situation of the business and trends for timber market in the future. All of them reported that despite the fact that the forest sector has been declining over the last two decades (one of them is even importing raw material from US), it is still a good business for investment and their perception on demand trend is positive. They agreed that the building sector is the most important niche market for timber trade in Belmopan, due to the fact that this city is developing faster than other urban areas of Belize.

Based on the above inputs, two indicators were identified in order to analyze demand: population change and building sector development in Cayo District.

Population change

According to the 2010 Population and Housing Census, among all the country's district, Cayo showed the largest population change in the last ten years (Figure 5). Positive population growth suggests that the demand for housing could even rise in future years. This is the case in Belmopan,

where migration of foreigners is increasing and some locals are arriving from Belize City looking for a safer place to live.

Development of the building sector

Housing construction in Belize is booming and the stimulus for it all is simply the availability of lots, access (streets and roads) to lot and, of course, financing (Henderson 2001). The 2010 Census reported an increase of 46% in dwelling units in the country (SIB 2011). Many sources of funding for housing exist in Belize and prospective homeowners simply need to have a stable job to qualify (CBA 2011). Of course, the level of present liabilities and access to land is critical to approval. The primary financing sources are the banks, credit unions, the Development Finance Cooperation and the Ministry of Housing. It is estimated that almost 80% of all housing loans are from these sources (Henderson 2001). Today, private banks, like Scotia Bank and Atlantic Bank, are giving affordable loans for residential projects.

In order to have a picture of the building expansion in Belmopan, the local building authority (City Council) was consulted. With its inputs, a trend line was constructed (Figure 6). This could give a good picture of the potential timber market for Mennonite communities due to the fact that their main market is the building sector.



Figure 5. Population change by district in Belize (2000-2010)

Source: SIB (2011)

Fuelwood demand

In Belize, demand for fuelwood and charcoal is not considerable because butane remains the most commonly used cooking fuel in all districts, except in Toledo (SIB 2011). In Cayo, 83.3% of the population uses butane for cooking; however in the Mennonite communities, fuelwood is the only source of energy for cooking and heating. Residents interviewed made a gross estimation of their consumption: around 6-7 ft³ of fuelwood per day in a family of ten members -the average size in these communities. It is evident the importance of fuelwood for Mennonite livelihood.

Furniture demand

In order to get a reference from the furniture sector as sawn lumber consumer, six cabinet shops

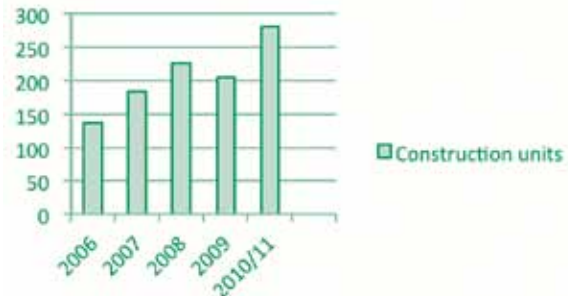


Figure 6. Construction units in Belmopan from 2006 to 2011

Source: Belmopan City Council (Personal communication)

were visited and consulted on their timber requirements. One of them expressed his rejection to Mennonite products basically because they are not high quality: cuts are not uniform and there is no drying process.

Regarding the local demand for furniture, the manager of a shop in Belmopan reported that it is very fluctuating. In San Ignacio, furniture shops (small artisans) reported a wide range of products offered but a weak demand. A big and popular furniture shop, very successful in the national market, assured that higher quality furniture is very much in demand by the tourism sector. This, however, is not the kind of client the Mennonite production is addressed to because of quality issues.

Pricing

The price of sawn timber is quite stable in the Belizean market; according to The Wood Depot Manager⁴, it has remained the same for the past 3 or 4 years. All the enterprises try to maintain steady prices, probably due to limited competition, the small size of the local market and the fact that this market does not demand high quality products.

Quam wood form board is the main product sold by the Mennonite communities. In order

Table 8. Market and on-gate prices of sawn lumber supplied by the Mennonite communities evaluated (US\$/m³)

Timber seller	Quamwood	Hardwood
On-gate prices		
Upper Barton Creek	231.00	352.00
Lower Barton Creek	154.00	193.00
Springfield	165.00	220.00
Market prices		
San Ignacio*	275.00	363.00
Belmopan	242.00	396.00

*Taken from Rosa Cruz (2010).

to compare prices, a market survey with the main timber dealers in Belmopan was carried out (Table 8). It is evident the big difference between the Mennonite's prices and the dealers'. As long as the Mennonites are supplier to the others, it can be easily determined the level of prices they could obtain if their timber were directly sold.

The two lumber yards in Belmopan reported that Springfield is not their only supplier, as the Mennonites provide quam wood form board only. This species is very soft and can be used just once; so it is preferred by homeowners and low-income customers. There are other clients such as carpenters, builders and contractors who are willing to pay more for hardwood species, like nargusta, santamaria, tamarind and yemeri with more resistant characteristics. The problem is that these species are no longer present in the Mennonite forests because of previous exploitation.

Nonetheless, quam wood has a secure market of buyers who want more affordable prices that Mennonites can provide. Therefore, the focus is not on quality but on price.

4 Emile Mena. May, 2011. The Wood Depot Manager. Personal communication.



Photo 8. The most sold product: Form board for construction is the best sold product by the Mennonite communities

Market prices of furniture and other wood items

Prices for timber products were gathered from Belmopan, Spanish Lookout and San Ignacio markets to compare with prices in Springfield. Most of the articles compared to those from Springfield's were made in Shipyard, a Mennonite community in Orange Walk District. These were more affordable and the finish quality was better (Table 9). The Mennonite communities evaluated do not offer furniture or other kinds of wood products in the markets of San Ignacio and Belmopan. Local people prefer to buy in town because they are not in the habit of traveling to other Mennonite communities –or, otherwise, to cities- to get products or commodities, even if they could get cheaper prices and better finished items.

Table 9. Market prices of Mennonite timber products (US\$)

Product	In Springfield	In Belmopan	In San Ignacio
Chair (rustic)	30.00	15.00	15.00
Chair (fancy)	50.00	20.00	25.00
Table	112.50	150.00	125.00
Bed	55.00	100.00	140.00
Wooden mobile house	3000.00	NDA*	**4300.00

*NDA: No data available.

** Same size of house made in Springfield.

Constraints and opportunities

Constraints

- Irregular supply of timber: there is not an abundant source of timber in any of the communities covered by the scope of the study.
- Interaction with external players is minimal. This limits the chances to upgrading quality and the expansion of lumber production. There is no outsourcing of services or alliances with other producers in the chain outside of the communities.
- Lack of technology for processing different products. Machinery is outdated and not in proper condition which results in low quality products.
- Processing low capacity and lack of technical standards to improve productivity.
- Lack of technical support. Mennonites are very open to implementation of new techniques as long as they don't clash with their religious beliefs. In the country, there is no extension service to provide the technical support they need in order to improve their performance.
- There is no marketing for Mennonite products.
- Mennonites don't have an idea of their products market value and competitors' rates.
- Because of religious beliefs, Mennonites may not want to change their way of living.

Opportunities

- There is a great opportunity to establish and improve silvopastoral practices in order to improve livelihood conditions. In BC communities some SPS experiences have been established and should be monitored and improved. In Springfield, few individual efforts are in place. Residents do not have the know-how to implement these practices properly but they have potential skills and are willing to do so.
- Both networking skills and communication mechanisms are in place and operative.
- Many residents have good artisan abilities and are very creative. Improving quality in their work, they could have more options in the rustic furniture market.
- There is a strong demand for timber in Belmopan. Efforts should be made to address this demand by introducing new timber species.

Lessons learned

- Despite the absence of quality and efficiency along the chain, there is no sale of logs. All the timber harvested is being processed at least into sawn lumber, which is an added value that is created along the chain.
- Mill operations are not isolated from livelihood strategies; therefore efficiency is a relative term. From the Mennonite perspective, there is no waste at the sawmill as far as all the remaining raw material is recycled into the farm system.
- Mennonites have not legally consolidated a timber trade organization or a small business enterprise focused on timber management; however they support each other in every step of the production process even if there is no profit.
- These communities supply a small segmented market characterized by the willingness to pay only low prices. The clients look mainly for price rather than quality.
- Mennonites lack information about SPS implementation and their economic benefits. They do not have the know-how to establish and monitor SPS.
- It remains in Belize the idea that forests are forever. This makes the forest the main source for timber extraction. This conception should be analyzed and new strategies implemented to achieve positive impact in SPS.
- The implementation of SPS projects in Belize should consider the forest's local image. The main reason for rejecting this kind of projects seems to be the fear to invest in initiatives without knowledge of the economic benefits and the lack of experience with intensive tree planting.
- Mennonite communities have very low costs of production due to their particular characteristics.
- The three communities keep both good record practices and track of their production and benefits. They value their experience, but there is still much room for improvement.

Conclusions

- The Mennonite communities have some religious principles that affect competitiveness of their value chain: no electricity, exclusive use of animal transport and isolation from population centers.
- The production of lumber in the three communities studied is not considered a major economic activity. Agriculture, including livestock production, is the main source of the family income.
- The lumber value chain is very simple and similar in the three communities. They follow a low value added processes. The chain largely revolves around the early stages: extraction of timber from the forest and transformation of logs to lumber.
- Lumber has a major role in energy supply in these communities because it is the major source of energy for domestic needs.
- The manufacture of rustic furniture generates little income to the household economy. Nevertheless, this activity, along with the construction of small mobile houses, gives more added values to the wood.
- The main source of timber is the forest; there is a very small amount of production coming from SPS. No enrichment plans have been implemented in the forests. This is a major concern because they are being depleted. In this sense, the three communities show great potential for SPS as an alternative source of timber, firewood and other wood products, thereby reducing the pressure on the remaining natural forest habitats and diversity while maintaining the availability of goods and services.

Recommendations

- Promote research in SPS concepts from the Belizean perspective to instill the knowledge into the local culture and way of thinking.
- Encourage the establishment SPS or agro-forestry systems in order to supply timber production. This is a key element in order to be sustainable in timber management: The forests around these three communities have largely been depleted of commercially valuable timber trees. There may, however, be opportunities to develop ‘community-based’ forest management initiatives, as well as more individualistic farm forest initiatives, involving enrichment of the forest and opportunities to carry out selective logging of commercially important secondary forest species.
- Encourage the appropriate use of felling techniques that should comprise directional felling, cutting stumps low to the ground to avoid waste,

and optimal crosscutting of tree stems into logs in a way that maximizes the recovery of useful wood.

- The three communities should take more control of their production process, quantifying the amount of logs before and after being processed, in order to track their yield.
- Promote the growth of some hardwood species, like nargusta, santamaria and yemeri that have a better price in the building sector.
- The communities should make alliances with buyers in the building sector (builders or contractors) who are looking for low costs to generate a win-win relationship.
- The land use changes since these communities were settled should be studied in order to estimate the remaining forest and its degradation process.

Bibliography

- Aldy, JE;Hrubovcak, J; Vasavada, U. 1998. The role of technology in sustaining agriculture and the environment. *Ecological Economics* 2(26): 81–96.
- Alonzo, Y. 2000. Potential of silvopastoral systems for economic dairy production in Cayo, Belize and constraints for their adoption. Thesis Mag. Sc., Turrialba, Costa Rica, CATIE. 81 p.
- Alonzo, Y; Ibrahim, M. 2001. Potential of silvopastoral systems for economic dairy production in Cayo, Belize and constraints for their adoptions. *In* Ibrahim, M. (Ed.) International Symposium on Silvopastoral Systems and Second Congress on Agroforestry and Livestock Production in Latin-American [April 2-9 2001, San José, Costa Rica]. p. 465-470.
- Beer, J; Ibrahim, M; Schlonoight, A. 2000. Timber production in tropical agroforestry systems of Latin America. *In* Forest and Society: the role of research. XXI IUFRO World Congress 2000 [7-12 August 2000, Kuala Lumpur, Malaysia]. Sub plenary sessions. p. 777-786.
- BNLSIS (Belize National Library Service and Information System). 2008. Mennonites. Consulted on May 2, 2011. Available on <http://www.nlsbze.bz/mennonites.html>
- Camargo, JC; Ibrahim, M; Somarriba, E; Finegan, B; Current, D. 2000. Factores ecológicos y socioeconómicos que influyen en la regeneración natural de laurel en sistemas silvopastorales del trópico húmedo y subhúmedo de Costa Rica. *Agroforestería en las Américas* 7(26): 46-49.
- Castellanos, J. 2009. The agriculture sector in Belize. Consulted on June 1st, 2011. Available on: <http://www.agriculture.gov.bz/Symposium/Presentations/agriculture%20sector%20in%20belize.pdf>.
- CBA (Construction Building Authority). 2011. Process for construction approval. Consulted on June 2nd 2011. Available on: <http://www.cbabelize.com/>
- CCAD (Comisión Centroamericana de Ambiente y Desarrollo). 1998. Estado del ambiente y los recursos naturales en Centroamérica. San José, Costa Rica. 179 p.
- Corbetta, P. 2003. Social research theory, methods and techniques. London, United Kingdom, SAGE Publications.
- David, M; Sutton, CD. 2004. Social research: The basics. London, United Kingdom, SAGE Publications.
- Donovan, J. 2006. Identificación de las oportunidades de mercado y mercadeo en cadenas de valor. Turrialba, Costa Rica, CATIE / CeCoEco.
- FAO (Food and Agricultural Organization of the United Nations). 1998. Website of the FAO. Consulted on May 2nd, 2011. Available on <http://faostat.fao.org>.
- FAO. 2004. National report Belize. *In* Latin American Forestry Sector Outlook. Belize Forest Department and FAO. Study Working Paper - ESFAL/N/17. 70 p.
- FAO. 2005. National report Belize. *In* Latin American Forestry Sector Outlook. Belize Forest Department and FAO. 70 p.
- FAO. 2010. La deforestación disminuye en el mundo pero continúa a ritmo alarmante en muchos países. Consulted on 29 April 2011. Available on <http://www.fao.org/news/story/es/item/40893/icode/>
- Feller, A; Shunk, D; Callarman, T. 2006. Value chains vs. supply chains. Consulted on May 3rd, 2011. Available on: <http://www.ceibs.edu/knowledge/papers/images/20060317/2847.pdf>.
- Fleischner, T. 1994. Ecological costs of livestock grazing in western North America. *Conservation Biology* 8(3): 629-644.

- Friesen, HP. 1989. Upper Barton Creek Colony, Belize. Global Anabaptist Mennonite Encyclopedia Online. Consulted on 11 May 2011. Available on <http://www.gameo.org/encyclopedia/contents/U64.html>.
- Gottret, V. 2009. Orientación estratégica para organizaciones de productores con enfoque de cadena de valor. Alianza para el aprendizaje. Consulted on April 29, 2011. Available on <http://masrenace.wikispaces.com/file/view/>
- Guevara, S; Laborde, J; Sanchez, G. 1998. Are isolated remnant trees in pastures a fragmented canopy? *Selbyana* 19(1): 34-43.
- Guevara, S; Meave, P; Moreno-Casasola, P; Laborde, J. 1992. Floristic composition and structure of vegetation under isolated trees in Neotropical pastures. *Journal of Vegetation Science* 3: 655-664.
- Harvey, CA; Harber, WA. 1999. Remnant trees and the conservation of biodiversity in Costa Rican pastures. *Agroforestry systems* 44: 37-68.
- Henderson, A. (Ed.). 2001. Building Inspectors Workshop. St. Johns, Ant. 15 p.
- Ibrahim, M; Schlönvoigt, A. 1999. Silvopastoral systems for degraded lands in the humid tropics: Environmentally friendly silvopastoral alternatives for optimising productivity of livestock farms: CATIE's experience. *In Actas IV Semana Científica del CATIE [CATIE, Turrialba, Costa Rica. 6-9 de abril, 1999]. p. 277-282.*
- Ibrahim, M; Franco, F; Pezo, D; Camero, R; Araya, J. 2001. Promoting intake of *Cratylia argentea* as a dry season supplement for cattle grazing *Hypparrentia rufa* in the subhumid tropics. *Agroforestry systems* 51:167-175.
- James, W; Jones, D. 2003. *Lean Thinking*. New York, The Free Press.
- Kaplinsky, R; Morris, M. 2002. A handbook for value chain research. The Open University Library's e-prints Archive. Consulted on April 29 2011. Available on: <http://liin-www.ira.uka.de/csbib/Misc/libeprints.open.ac.uk>.
- Noss, R. 1994. Cows and conservation biology. *Conservation Biology* 8(3): 613-616.
- OECD (Organisation for Economic Cooperation and Development). 2004. Glossary of Statistical Terms. Consulted on June 10th 2011. Available on <http://stats.oecd.org/glossary/detail.asp?ID=940>.
- Pezo, D; Ibrahim, M. 1999. Sistemas silvopastoriles. Turrialba, Costa Rica, CATIE. 276 p. (Materiales de Enseñanza CATIE No. 44).
- Rosa Cruz, A. 2010. Desafíos de la legislación forestal para el aprovechamiento del recurso maderable en sistemas silvopastoriles del Cayo, Belice. Tesis Mag Sc. Turrialba, Costa Rica, CATIE. 108 p.
- Russo, L. 1990. Agroforestry in the northern Mexican drylands: A case study from Durango. Master's Thesis. Tucson, Arizona, USA, University of Arizona. 120 p.
- Sabido, W. 2007. Informe del segundo taller regional sobre la tala y comercio ilegal de madera y gobernabilidad. San Pedro Sula, Honduras. Roma, Italia, FAO. 61 p.
- Santos, T. 2011. Systematization of the management of the agro-forestry system in the Mennonite communities of Upper Barton Creek and Lower Barton Creek, Cayo District, Belize. Belize, CATIE- Finnfor Project. sp.
- Sathre, R; Gustavsson, L. 2009. Process-based analysis of added value in forest product industries. *Forest policy and economics* 11: 65-75.
- Scheelje, JMB. 2009. Incidencia de la legislación sobre el aprovechamiento del recurso maderable en sistemas silvopastoriles de Costa Rica. Tesis Mag Sc. Turrialba, Costa Rica, CATIE. 156 p.
- SIB (The Statistical Institute of Belize). 2011. 2010 Population and Housing Census Launch Press Release. Consulted on April 29 2011. Available on www.statisticsbelize.org.bz
- Sharrow, SH. 1999. Silvopastoralism: competition and facilitation between trees, livestock and improved grass-clover pastures on temperate lands. *In* Buck, LE; Lassoie, JP; Fernández, ECM. (Eds.). *Agroforestry in sustainable agricultural systems*. Boca Ratón, USA, Lewis. p. 111-130.
- Souza de Abreu, M; Ibrahim, M; Harvey, C; Jiménez, F. 2000. Caracterización del componente arbóreo en los sistemas ganaderos de La Fortuna de San Carlos, Costa Rica. *Agroforestería en las Américas* 7(26): 53-56.
- Supply-Chain Council. 2005. Website Consulted on May 2, 2011. Available on: www.supply-chain.org
- Trujillo, E. 2009. Silvopastoreo: Árboles y ganado, una alternativa productiva. Consulted on May 3 2011. Available on http://www.revista-mm.com/ediciones/rev62/forestal_silvopastoreo.pdf

ANNEX 1: Questionnaire for semi-structured interviews

1. Organization

- Who is the person in charge of the timber management in the community? Who regulates this issue?
- Where do you normally log?
- If it is outside of the community land, do you agree on something with the landlord?
- Do you pay a fee to the landlord per species or tree logged?
- Is there any strategic alliance or association with another community or person to process timber?
- How many people in the community are involved in this activity?
- How many people operate the sawmill? How is the sawmilling system?
- How old is the sawmill?

Persons in charge of:

- felling
- transport from felling point to collect point
- sawmilling
- transport from sawmill to final destination
- Is there a fee for sawmill usage? How much is it?
- What is the main income generation in the community?
- Can you rank the timber extraction in relation with other income generation activities?
- How is the allocation of land? Who decides this topic in the community?
- What is the total acreage of the community? What percentage is for agriculture?..for live-stock?...forest? How much has changed this situation from the beginning until today?

- How is the decision making process in the community?
- Are there some rules or instructions to regulate the sawmill use?
- How many sawmills are operating in the community? What is the installed capacity? Describe the machineries that you have and use?

2. Production

- How does the process start? ...per received order? ...timber processed periodically? ...sawn wood stored?
- How do you source the timber production? What percentage comes from: forest, SPS and plantation?
- Could you mention the steps from tree logging to getting to sawmill?
- What happens when arriving to the sawmill? Who receives the timber and how the process continues until final product?
- How do you calculate the waste? Do you have an idea about the yield per species?

- How much wood do you process periodically? Do you have any records of your production? What do you record? Why?
- Which species do you use more frequently?
- Which are the main timber species in the forest?
- Is there any enrichment plan in the forest or project to supply the timber production?

3. Trade

- How is the trade? How the buyers know about your offer?
- In your opinion, why do you think buyers prefer to buy you instead of other businesses in town?
- What is the main use of the wood: for sale or for household?
- Final destination of wood: how much is for household and how much is for trade?
- How much is for charcoal or fire wood?
- How is the trade with other members of the community?

- What is the most sold product? Who are the buyers? Who is the biggest buyer? Do you know if your clients sell your timber to others? What could be the final destination?

- What percentage of your production goes to lumber yards (intermediaries)? At what price?

- How do you sell it? What percentage is sold at the sawmill, and what percentage is delivered to town?

- In what terms the transport is agreed?

4. Costs

- For logging:

- What inputs do you use?

- How do you calculate the current price of oxen and carts?

- How much you charge for sawn timber? Is there any difference among species?

5. Sales

- Is there someone in charge of sales?

- What are the prices of the products?

6. Record keeping

- Do you have any inventory of your production?

- How do you choose the desirable tree?

- Do you have cost and maintenance records?

7. Regulations

- What kind of regulation do you hold with the Forest Department?

- Does the Forest Department control the logging in the field? How often do they arrive to control? What is the procedure to obtain a license or Petty Permit? Is it easy to get it?

8. Furniture

- Is there someone in your community who processes the timber to make furniture? Does he sell it to outsiders or it is for community use?

- Is there any carpentry in the community?

- Does the carpenter get the raw material from the community sawmill or he buys it outside?

To the carpenter

- Which is the most sold product?
- How much does it cost?
- To whom do you sell?
- Is it by order or periodically?
- How many pieces do you sell?
- How many tools are there in the workshop?
- How long it takes to make the product?
- What other products do you sell?

9. Wooden houses

- How many people are involved in this activity?
- When did you start building houses in the community?
- What type of timber do you prefer to build a wooden house? What are the sizes of the houses?
- How much timber do you need to build it?
- What is the production cost?
- What is the price?
- Where do you sell it?
- Who are the buyers?

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