Economic Evaluation of Timber and Non-Timber Forest Products of *Cordia dodecandra* Tree in the Southern of Mexico

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Summary

This study investigated the potential market for Ciricote (*Cordia dodecandra*) products: timber and fruits and their profitability in Yucatan State, Mexico. In order to assess the market potential and to compare the economic benefits of fruits and timber for rural households, an economic evaluation was undertaken from the household level up to the local first-level of buyers. The methodology used for this purpose was the Cost-Benefit-Analysis (CBA), using for decision criteria: Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit Cost Rate (BCR). The rotation period was 60 years for timber production and 40 years for fruit production. The financial analysis for a 60 years rotation period shows that at smaller interest rates, timber production presents higher net present value and benefit cost rate than fruit. With regard to the value chains for timber and fruit production great differences can be observed. The timber value chain has more actors involved than the fruit production value chain; therefore the transaction costs in lumber industry are higher. Nevertheless timber has a larger market than fruit. Approximately 1000 m^3 of timber are demanded by the market which means that there is a potential demand of 300 has of ciricote tree. The price of ciricote timber could reach 45 pesos/board foot vs. 30 pesos/board foot of mahogany (*Swietenia macrophylla*). The price of ciricote fruit is 1.5 pesos/kilo and the potential market for fruits (22,900 kg of raw fruits) will be covered with 6.0 – 7.0 ha of ciricote for fruit production. It was found that the additional income from other sources is very important for Mayan peasants due to participation in farm as well as non-farm activities. Farm households diversify their economic activities in order to cope with crop shortfalls and to overcome credit and land market constraints. Ciricote based agroforestry systems contribute to income and risk minimization by diversification of crops.

Key words: *Cordia dodecandra* (ciricote), agroforestry, cost benefit analysis, timber, non-timber forest products, Mayan peasants.

Introduction

The Mayan peasant farming families of the Yucatan Peninsula in South East Mexico have traditionally depended upon a "Slash-and-burn" system of staple food production. In the past this "milpa" system (i.e., maize together with a number of other food crops) was able to satisfy the food needs of the population; however the introduction of large scale cropping, for e.g. sisal (*Agave furcroydes*) and the development of extensive cattle ranching have increased land pressure, reduced fallow periods and soil fertility and caused deforestation.

Nowadays, some institutions are doing some efforts in order to develop alternatives strategies for agricultural production such as agroforestry projects. The IAI (Inter-American Institute for Global Change) with the Project CRN001 "Biogeochemical Cycles under Land use Change in the Semiarid Americas" is investigating silvicultural management of some natives' trees in agroforestry schemes. In addition, the Mexican Department of Forestry (CONAFOR) is now encouraging research programs on reforestation with native tree species.

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One potential species for reforestation is the multi-purpose tree *Cordia dodecandra* (Ciricote) which originates from the Yucatan Peninsula. It produces fruits and valuable timber. Because of the high economic value of its timber it is an endangered species due to overexploitation (SEMARNAT 1997).

Materials and Methods

Study Sites
A survey was conducted throughout the state of Yucatan, which is located in the north-western corner of the Yucatan Peninsula. The area is 43.379 km^2 with 3.015 towns. The studies reported in this paper were carried out in the northwest of the peninsula in the communities of Hocaba and Sahcaba (20º45N), Dzan (20º23N) and Uayma (20º40N).

Data collection
Data are based in semi-structured interviews with the different actors of the production market chain (small-scale farmers, middlemen, wholesalers, processing industries). To supplement any information missing from documents and field notes regarding to ciricote, other interviews were conducted with leading, technicians, university lectures and researchers in Merida (Yucatan State) and Chetumal (Quintana Roo State).

An agro socioeconomic survey applied in 2003 by PROTROPICO in many villages through Yucatan State was used in order to select the communities and homes for the survey.

Cost Benefit Analysis
A tree planting scheme with Ciricote is evaluated using three criteria, net present value (NPV), benefit cost ratio (BCR) and the internal rate of return (IRR). NPV is the algebraic sum of all cost and revenues discounted at a stated rate. Discount rates are usually chosen to reflect the return on alternative investment opportunities. In Mexico, real discount rates of 5% and 10% are used. A project is feasible if the NPV is positive. The ratio of discounted benefits and discounted costs of a project is called benefit-cost ratio (BCR). A BCR higher than one indicates that a project is advantageous. The IRR is the discount rate at which NPV is zero. A project is feasible if IRR is greater than the alternative rate of return. (Olschewski 2001; Godsey 2000)

All analyses were made using the following assumptions:

- All calculations are based on one hectare of agro forestry scheme and using a 60 year of rotation period for timber because the older timber could get better price. For fruit production a time rotation of 40 years is considered because during the period of 25 to 40 years fruit production achieves the maximum productivity.

- Only the Ciricote component of the agroforestry scheme is evaluated.

- The applied rates of discount were 5% and 10%. These discount rates were considered because they reflect the market discount rate. No financial costs due to loans are included. This is because according to farmers, conditions for loans are too difficult to meet and the majority of them do not work under this system.

- Costs and ciricote product prices are in Mexican pesos units. No inflation is considered.

Financial analyses are made from the social planner perspective. Governmental programmes supporting input use or investments for reforestation are not taken into account due to the temporal character of these programs.

The data collected was qualitative and quantitative. The data assembled by questionnaire was entered into Microsoft Excel as a data bank. The data has been analyzed by using the Statistical Package for Social Sciences (SPSS).

Results

Management Systems

The agroforestal parcel model used was the same than the one used by the project "Nutrient Limitation on Growth and Fruit Production of Mayan Tree Species on Degraded Land in Yucatan, Mexico". The parcels are located in Xmatkuil, which is close to Merida.

The agroforestal model is circular with 7 m of diameter and 4 m of distance between plants. In each parcel, there are 4 plants of Ciricote (*Cordia dodecandra*) and 4 plants of Achiote (*Bixa orellana*) which will be used as a cash crop. In 1 ha, 204 parcels were established. Approximately 800 plants/ha were planted. The land was cleared and plants with an age of 6 months were planted before the rainy season. Weeding occurred after establishment and weeding and replanting occurred throughout the first year. In the first year 85% of survivors were observed (Reuter 2003), but this percentage could be increased to 90-95% (Parra 2003). In the year that the plantation was establishment (2002), Isidoro´s hurricane took place in Yucatan Peninsula.

For timber production trees are pruned periodically from 2 to 8 years in order to support and enhance the growing of the tree and to improve quality. The branches could be sold like as firewood. According to Haggar (1999), first thinning occurs in year 10 and 50% of tree population will be removed. Thinning trees could generate intermediate income from fence and fuelwood. In year 25, the second thinning will be necessary (more or less 30% of trees). The final number of trees will be 280 trees/ha.

For fruit production, trees with many branches are desirable for fruit production, for that reason pruning will not be carried out at the early stages. The fruit production begins in the 4th year and it is continuously rising until year 25. After the 25th year production is stationary. The fruit production begins to decrease at an age of 40 years.

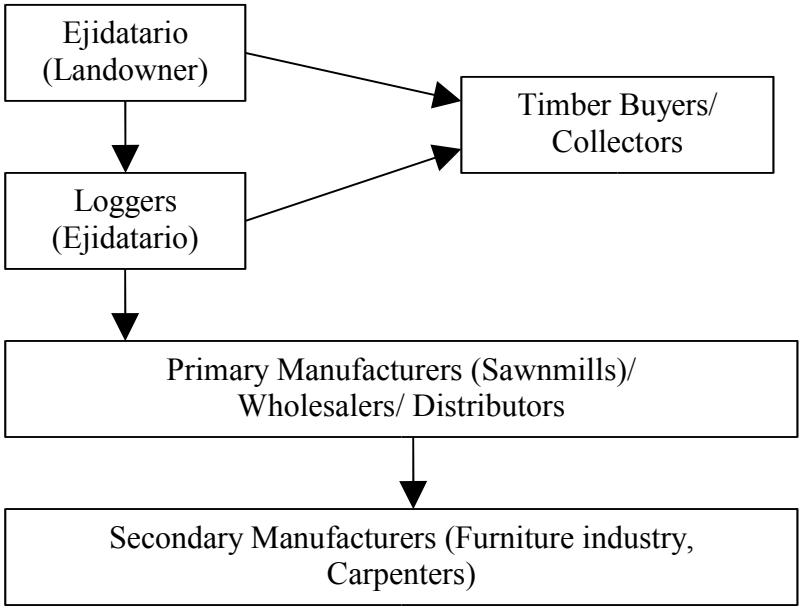
Local Market Structure for Cordia dodecandra Products

The first step of research about local market structure for ciricote products was the investigation of the farmer's perception about ciricote trees. Eighty surveys were applied. Farmers, in most cases stated two or more uses of the ciricote tree. 30% used for furniture and construction, 75% used for preparing a dessert, 76% used the leaves like as sandpaper, 9% used for firewood, 13% have another uses and 5% don't know about it.

Householders used very little ciricote wood. While fruits in Dzan, Hocaba and Sahcaba are used in 56% to 68% of the households, wood use only accounts for a maximum of 18% of the households (Dzan).

Fourteen surveys were carried out with companies in the lumber industry. According to the interviews in the timber industry in Merida, the value chain could be explained as follows:

Figure 1. Timber Value Chain in Merida



Ejidatario or householder is the owner of the forest.
Collector is a person who buys the wood in different ejidos or community lands.

Companies buy imported timber from USA and Canada. The most common imported wood is pine. Exotic tropical wood is imported from Brazil, Malaysia and Peru. Some companies also buy wood from the Mexican States of Chiapas, Campeche and Quintana Roo. Small firms buy wood from distributors located in Merida.

Survey shows that 29% of the firms are interested in ciricote wood. Some entrepreneurs ascribed a higher value to ciricote wood that to mahogany 45 pesos vs. 35 pesos/board foot.

There is no developed ciricote market, although the surveyed companies buy a large variety of tropical woods (soft and hard). The quantity share of the particular woods are different but ciricote occurs very rarely due to its scarcity in the forest, which prevents a continuous supply. The potential uses of ciricote according to the surveyed firms are: 14% construction, 50% furniture, 7% handicrafts and 28% don't know. With regard to the potential consumers' demand 50% of surveyed firms expressed that consumers would be interested in ciricote wood. In all the cases, the beauty and durability of the wood are the common reasons.

Asked about the knowledge of sources of ciricote supply 64% of the surveyed companies indicated that it is not easy to find ciricote. 93% of them indicated that they did not know if there were any ciricote plantations. Only one enterprise surveyed knew that one ciricote plantation is established in Tixkocho (Campeche State).

On average, transportation costs are 25% of the total raw material costs, according to some managers. But they also said that the government is investing in road construction. A new highway from Merida to Cancun is under construction and many communities could be benefit from this development of infrastructure, especially regarding the fact that some managers prefer to pay for timber delivered to their sawmills or companies instead of picking it up from the field.

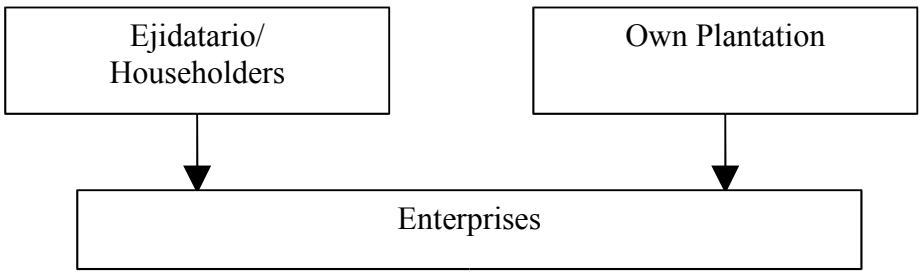
Fruits

Only one company in Merida (AAMSA) is processing the ciricote fruit. The firm produces conserves of ciricote. According to the production manager, the company is interested in buying more fruits of ciricote. At the moment they supply themselves with their eighteen years old one hectare plantation of ciricote located in Merida. As the supply from this plantation is not sufficient the firm additionally buys more fruits in Campeche, another Mexican state. The yield from the own plantation provides for 3.200 jars per year. Additionally purchased fruits from Campeche cooperatives provide another 6000 jars per year. Every jar contains 680 grams of ciricote fruits. The yield of proceeded fruit amounts to 60% of raw fruits weight. The cost of one kilo of ciricote in almibar is 3 pesos without glass package and the supermarket price is 16 pesos.

Another company (Conservas Doña Cruz) in Chetumal, Quintana Roo, is interested in buying fruit from householders. The fruit in Chetumal is already scarce and the firm is planning to open a shop in Cancun, which will allow for additional sales. They produce annualy 4000 units of three different package-weight jars: 1 kilo is sold for 35 pesos, 500 grams are sold for 25 pesos and 250 grams are sold at a price of 20 pesos.

According to the surveys carried out in the fruit industry in Merida and Chetumal, the value chain can be sketched as follow:

Figure 2. Fruit Value Chain



Both firms expect a sale increment of 50% in volume term for the next 5 years. The consumption is mainly local, but eventually some tourists buy the dessert. According to the managers, the principal characteristic of ciricote dessert is a unique flavour which is very appreciated, especially by local people.

The main problem with ciricote fruit is its perishable character, the duration of the fruit is 4 days before it begins to oxidise.

Economic Analyses

Timber is more profitable than fruit production (Table 1) when the rate of discount is smaller, in the case than the rate of discount is greater than 9%, fruit production is a better option. As the economic theory says, for long term, projects with low discount rates are better and in this case the maximum discount rate will be 9%.

Using IRR approach all investments are recommendable, due to the fact the interest rate in Mexico amounts 5%. Fruit production has higher IRR than timber production which makes sense because fruit is food and the production lasts longer time compared with timber production.

The Benefit-cost ratio indicates that timber generates the maximum return for the available budget. In most cases, BCR is more than 1, which means that most of the investments are also recommendable using BCR, with the exception of timber production with 60 years of rotation period and 10% of discount rate.

Table 1. Profitability Analyses

Option	Discount Rate	NPV	BCR	IRR
Timber	5%	264.969	5,61	9%
(60 years)	10%	-12.314	0,67	9%
Fruit	5%	102.473	2,11	14%
(40 years)	10%	29.995	1,54	14%

NPV = Net Present Value
BCR = Benefit Cost Ratio
IRR = Internal Rate of Return

Considerations:
NPV in Mexican currency
1 US$ = 11 Mexican pesos

Discussion and Conclusions

Ciricote tree in agroforestry schemes should help to achieve development objectives and increase household's income. Although subsidies do not play a significant role in determining profitability of the system, they are useful for increasing the rate of adoption. The technical assistance provided along with subsidies is also important, particularly since native tree species are being promoted.

The results show that local market structure for *Cordia dodecandra* products in Mexico is complex due to high transaction costs, like as most of Latin countries. The value chain for timber and fruit production (figure 1 and 2) has greater differences. Compared with the fruit production value chain, the timber value chain has more actors involved. This is one reason for give higher transaction costs in lumber industry.

Actually, wood industry in Merida is disorganized. Some illegal practices are common and access to information on new technological is not very well spread. Smaller industries have limited access to new technologies. There are imperfections in the wood market because a lack of comprehensive and reliable information system to support the potential buyers and sellers decision making. Approximately 80% of production continues to occur on lands that are owned under community based management structure.

Although the general scenario does not look very optimistic in lumber industry, there are other aspects which have to be taken into consideration: one advantage of Mexico's forestry industry lies in its geographic proximity to the U.S., the world's largest market for forestry products. Other advantages include the ease with which workers can be trained, cheap labour costs, and reasonable energy prices. Finally, it is important to mention that ciricote wood is considered a good quality,

beautiful and durability wood. Those characteristics could be helpful to develop a high value niche market.

On the other hand, the fruit industry is formal and the managers are more willing to share information. But there are only two enterprises, one in Merida and the other one in Chetumal.

At this moment, there is a potential demand for products of ciricote. According to the survey, wood production has a greater potential market than fruit production because the volumes in timber industries are high. Also potential international market exits based on past experience. Quintana Roo exported ciricote to Japan and Germany until 1997. The volume of ciricote wood is difficult to quantify due to the lack of information but roughly, according to the experts, at least 300 ha of ciricote for timber production would find a market ($1000m^3$). It is important to know that for 2004 consumption of imported tropical lumber is forecasted at 195,000 m^3, due to an expected strong demand by the furniture industry. The domestic construction sector also purchases some quantities of hardwood lumber for uses such as decorative wood. A further important buyer is the molding industry.

The potential market for fruit production (22 900 kg of raw fruits) will be covered with 6.0 – 7.0 ha of ciricote for fruit production based on agroforestry management due to the high productivity of each mature tree (35 kilos per year) or could be reached with the plantation for timber production.

It is important to add value to products. For that purpose, a company must start by determining the purchasing criteria of the customer(s). For ciricote and other woods, value can be added in many ways, including :

a) Improving product quality by removing defects and maintaining consistently better product standards.
b) Promoting and marketing the benefits of ciricote: decay resistance and insect resistance, beautiful strips.
c) Changing the shape of the products.

In the region, a strong impulse is required to activate the agroindustry and to take advantage of the peninsular markets (Cancun and Merida) and international markets, especially the U.S.

Recommendations

Based on this study, the following recommendations are made for an improvement, if the implementation of agroforestry systems with ciricote will be carried out:

This asssessmest is basically of a qualitative and quantitative nature. But more quantitative assessment of the performace of some of the projects should be conducted. This will of course require a longer period of time to collect data. Also studies on ecological and economic implications of the dynamics of agroforestry associations with *Cordia dodecandra* should be carried out.

Finally, this study indicates that farmers are not very familiar with ciricote-based agroforestry because reforestation projects in Yucatan still focus on mahogany (*Swietenia macrophylla*) and cedar (*Cedrela odorata*). It will be necessary to know more about the process of adoption of new agroforestry technologies in the mayan communities.

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