

Final Draft

**Note
on
Smallholder Farm Yields in “La Amistad,”
the Opportunity Cost of Maintaining Existing Forest, and
Parameters for Payment for Environmental Services**

**Supplement to Prior Report
“Land Use Trends in the San Rafael
Resource Management Area”**

Prepared for World Land Trust and Guyra Paraguay

by

Peter M. Hansen

**with the collaboration
of
Marcelo Arévalos (farm data)
and
Fernando Palacios (satellite imagery)**

**April 6, 2010
Asunción, Paraguay**

Table of Contents

Introduction	3
I - Farm Yields and Financial Returns to Smallholder Crop Production in La Amistad	3
II - Opportunity Cost and Reservation Price for Maintaining Existing Forest	5
III – Parameters for Payment for Environmental Services	6
 Attachment 1 - Principles for Payment for Environmental Services in La Amistad	 11
Attachment 2 – Possible Distribution of Payment for Environmental Services, with Alternative Scenarios	 12
 Annex 1 - Maps and Satellite Images (in .jpg format)	
1. La Amistad – forest cover and land use by smallholder plot, 2008	
Annex 2 – Worksheet for calculating the distribution of payments for environmental services (Excel file)	

Introduction

This Note supplements a prior report, “Land Use Trends in the San Rafael Resource Management Area,” dated January 25, 2010, that was prepared for the World Land Trust and Guyra Paraguay as background information and analysis for a possible carbon sequestration project.

The prior report analyzed the changes in land use in the San Rafael area during the past decades. These were identified as mainly i) a strong growth in the cultivation of soybeans in the Department of Itapúa right up to the southern and eastern borders of the San Rafael reserve; ii) the establishment of smallholder settlements on the northern and western side of San Rafael in the Department of Caazapá, e.g., the settlement of Lima, in which about 90% of the high forest was deforested within those settlements; and iii) the establishment in 1998 of a new smallholder settlement, La Amistad, within the San Rafael reserve area on land purchased from a private owner.

The report concluded that the pattern of land use change in La Amistad during the past decade, namely, gradual deforestation and conversion of land to subsistence farming, followed a similar pattern as in the neighboring smallholder settlements and that the remaining forest cover within La Amistad (currently about 43% of the original high forest) would most likely disappear over the next 5-10 years.

The prior report also summarized the results of a survey of the socio-economic conditions in La Amistad and proposed a set of principles to guide the payment for environmental services in the event the proposed carbon sequestration project is approved and La Amistad is included as one of its components. These principles are reproduced as Attachment 1 to this Note.

This Note analyzes the financial returns to smallholder production in La Amistad, discusses the opportunity cost for the settlers to maintain their remaining forest, instead of cutting it down to expand production as could otherwise be expected, and estimates the amount of payments necessary to entice the settlers to enter a voluntary sustainable forest management scheme on their land.

I – Farm Yields and Financial Returns to Smallholder Crop Production in La Amistad

As mentioned in the prior report, “the settlers sustain themselves with activities for auto-consumption, including raising small animals (chickens, pigs, some cows) and rudimentary farming (maize, manioc, beans, sugarcane for molasses, etc.). Most settlers, nevertheless, have one to three hectares of commercial crops (cotton, sesame and/or soybean) that they sell for cash. The prices received for these cash crops are nevertheless below market due to the long distance and poor roads they must travel.”

Cotton has long been the traditional “cash” crop for smallholders in Paraguay. However, smallholders are moving away from cotton due to better returns from other crops such as sesame, which is easier to cultivate, requires less cash inputs, fewer days of labor, and is less prone to insects and disease than cotton.

The following table illustrates some of these points. The cash costs of inputs for sesame are about one-half those for cotton, while the days of labor required for sesame (40) are less than for cotton (52). While the gross income per hectare is about the same for both crops, the higher input and labor costs for cotton result in a much lower net income for cotton, \$59 per hectare, than for sesame, \$225 per hectare. For these reasons, smallholders are moving into sesame production, and this trend is also occurring in La Amistad.

Returns to Smallholder Farming in San Rafael Area

(per hectare by crop)

	Sesame		Cotton	
	Gs.	US\$	Gs.	US\$
Estimated yield (kg/ha)	800		1,800	
Farmgate sale price (per kg)	3,200	0.68	1,400	0.30
Gross income per ha.	2,560,000	545	2,520,000	536
Cash costs (excl. labor)	316,407	67	690,599	147
Days of labor	40		52	
Labor costs (own or hired) a/	1,185,000	252	1,552,000	330
Total cost per ha.	1,501,407	319	2,242,599	477
Net income	1,058,593	225	277,401	59
Memo: net income using own labor	2,243,593	477	1,829,401	389
Source: Unidad de Estudios Agroecón—micos - DGP - MAG - IICA				
Exchange rate (Gs. / US\$)	4,700			
a/ Daily wage rate for farm labor	Gs. 30,000			

The above data are from Ministry of Agriculture (MAG) model farm budgets for traditional (animal powered) smallholder farming in the Eastern Region, as would be the case in La Amistad.¹ However, the budgets assume efficient production methods, which is not the case in La Amistad where settlers do not use the full complement of inputs (e.g., sufficient seed) or good farming practices. Also, the isolated location of La Amistad deep within the San Rafael reserve area and the poor roads joining La Amistad to the outside world result in higher transport costs and lower farmgate prices than shown above.

The result is that production (kg/ha) and income in La Amistad is likely to be less than the amounts shown above. Indeed, a calculation based on cash income data from the socio-economic survey of 62 settlers in La Amistad (see prior report) indicates an average cash income of about \$110 per hectare of area farmed (result not previously reported).

In the case where the smallholder uses his own labor for production, the net income is higher for both crops, although the outcome is still more favorable for sesame than for cotton. The use of own labor is probably the case for the first 1-2 hectares of production. Two hectares of cotton would require 104 days of labor, which would keep a smallholder fully

¹ Corresponding data for soybean production does not exist. The only model farm data available for soybean are for mechanized agriculture (tractor powered and including the rental of land), which are not applicable to La Amistad.

employed during the four-month growing season, plus some pre- and post-crop farm activities. For a settler to farm more than two hectares, however, either he would need some surplus family labor (e.g., children) or would have to hire local farm labor.

To summarize, reported cash income is \$110 per hectare in La Amistad. A settler using his own labor and efficient farming methods could potentially earn up to \$350 to \$450 per hectare planting some combination of cotton and sesame on the first two hectares. Potential net income from planting additional hectares would fall to the \$60 to \$225 range due to the use of hired labor, and the choice of crop would probably be sesame. Currently, these amounts of net income are likely to be significantly less than shown, given the poor farming methods and undercapitalization of the settlers in La Amistad.

II – Opportunity Cost and Reservation Price for Maintaining Existing Forest

The net income in the preceeding table is thus indicative of the potential returns a farmer in La Amistad could earn with better farming techniques (i.e., with technical assistance) and with additional working capital to finance the full complement of crop inputs. Given the higher returns to sesame and the likely need to hire labor to expand production beyond two hectares, the net income for sesame using hired labor represents the opportunity cost of preserving a hectare of forest and not expanding production.

However, the smallholder in La Amistad today may not fully appreciate the factors underlying the opportunity cost calculated above. He may be content to continue to farm only part of his land and thus not have any opportunity cost of not expanding production. Or he may think that the net income from farming additional land would be equal only to his current low level of income per hectare. In this respect, he may not appreciate the potential increase in income that could occur with better farming practices and additional capital. The farmer may thus be willing to maintain his forest for less compensation than the potential return to sesame. In other words, the farmer may have a lower reservation price for participation in the project than the opportunity cost calculated above.

His actual reservation price will only be revealed by the negotiation to be had between principal (Guyra, on behalf of the project) and agent (the farmers), each of which will approach the negotiation with different information and from opposing points of view – Guyra desiring to pay the minimum necessary to maintain an hectare of forest, and the farmers wishing to receive the maximum possible for each hectare of forest committed to the program.

For purposes of framing the negotiation, the minimum reservation price is thus likely to be \$110 per hectare, equal to the amount of reported average income per hectare, while the maximum justifiable price would be \$225 per hectare, equal to the opportunity cost of not expanding production and farming an additional hectare of sesame using efficient methods.

minimum reservation price (\$110)	<<< >>>	negotiated price (\$???)	<<< >>>	opportunity cost of sesame (\$225)
--	---------	--	---------	---

A further consideration for the negotiations is the risk, or moral hazard, of offering technical assistance to the farmers to improve their productivity. To the extent that the project offers technical assistance to increase farmer productivity and incomes, the farmers may increase their reservation price towards the full opportunity cost of sesame. That is, if they are today earning, say, \$150 from sesame, and the project promises to provide technical assistance so that they can then earn \$200 from sesame, the farmers are likely to demand \$200 as the negotiated price for maintaining forest and entering the project.

Furthermore, if the farmers do not fully appreciate the opportunity cost of sesame at this time during negotiations, and settle for a lower negotiated price, they may later realize during the project, once they receive technical assistance and improve their productivity, that the negotiated price is lower than the opportunity cost of sesame. At that point, they may ask for higher compensation for the rest of the project life, or may opt out of the project and deforest additional hectares to plant sesame.

III – Parameters for Payment for Environmental Services

Subsequent to the prior report, a detailed mapping was made of the 80 individual properties in La Amistad based on the official survey of the settlement done by the *Instituto de Bienestar Rural* (IBR) in 1998. The plots were overlaid on a high-resolution 2008 satellite image of the area² and a new map was made showing the remaining forest, areas currently in agricultural use, and natural pastures.³ This map is attached as **Annex 1**.

The official survey delimited a settlement area of 1117 hectares that was at the time about 40% natural pasture and 60% forest.⁴ The land was divided into 80 lots for settlement, totaling 609 hectares (almost all in the forested area), and the rest (mostly pasture with some forest) was reserved for public and commons areas, including 2 lots for public services such as schools and health clinics (see following table).

IBR Survey, 1998		Remaining forest 2008/10	
Private	hectares	high	low
80 lots assigned to settlers	609	224	10
Public			
2 lots for public facilities	10	6	
roads	16		
commons (pastures + forest)	483	57	
Total	1117	287	10

Based on the most recent satellite images available (footnotes 2 and 3), it is estimated that 297 hectares of forest (high and low) remain within the official settlement area. (The remaining forest represents about 43% of an estimated 685 hectares of original forest within

² CBERS 2B HRC of August 30, 2008, with resolution of 2,5 meters. A more recent image at this resolution level is not available.

³ The resulting map was compared with a January 31, 2010 Landsat image (30 meter resolution). No significant change in land use was identified.

⁴ The prior report analyzed an area of 1183 hectares that included some additional forest and pasture that lie outside the official settlement polygon along the rivers and streams to the west and southwest of the polygon.

the settlement polygon.) The majority of the present remaining forest (234 hectares, or 79%) lies on land allocated to the original 80 settlers. The rest, including 6 hectares of forest on the two public service lots, belongs to the community at large.

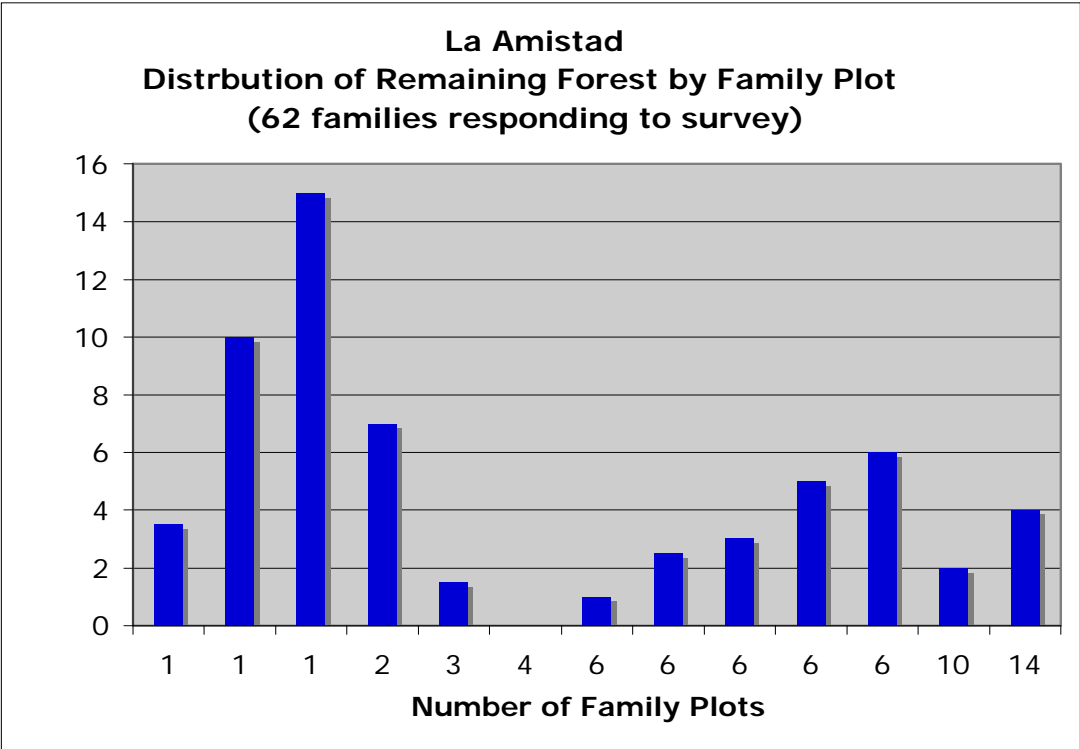
It should be noted, as discussed in the prior report, that in the period since the original settlement in 1998, some 27 additional “squatter” families have illegally settled on the commons areas, where some of the subsequent deforestation has occurred. These families are nevertheless considered as part of the La Amistad community.

The current pattern of land use within the official settlement area is as follows:

La Amistad - Current land use (2008/10)

high forest	287
low forest	10
agriculture	360
fallow (" <i>barbecho</i> ")	25
natural pastures	435
Total	1117
see Map, Annex 1	

Regarding individual forest holdings, the 62 settlers who responded to the socio-economic survey reported an average of 3.5 hectares of forest remaining on their plots, for a total of 228 hectares (see prior report for further details). The distribution of these declared forest holdings by family plot is shown in the following graph, e.g., there are 14 families who declared four hectares of forest each.



The total amount of forest declared by the respondents, 228 hectares, roughly corresponds with the 234 hectares of private forest identified in the map overlay of settler plots on the satellite image (Annex 1). However, the respondents may have overestimated their individual forest holdings, since the survey did not capture the other 18 original settlers who probably also have some forest on their land, which would bring the total of declared forest above the amount of observed forest by satellite.

As discussed in the prior report, smallholder beneficiaries of the Agrarian Reform are not subject to the Law of Zero Deforestation, which is currently in force for the Eastern Region of Paraguay. Nor are they required to maintain the 25% forest reserve that applies to other (larger) landowners.⁵

The settlers in La Amistad will continue to have demand for wood for building homes, fences, tools and firewood. They may also wish to expand agricultural production and clear some of their remaining forest. Indeed, a few settlers have already cleared their land to the full extent possible down to the southern boundary of the settlement. At the rate of deforestation over the past six years (about 20 hectares of high forest per year), it could be expected that the majority of settlers would exhaust their own forest resources within the next 5-10 years and then put increased pressure on the San Rafael Reserve forest.

The challenge for the proposed carbon sequestration project is thus to create a set of incentives that would be attractive enough for the settlers to forgo further clearing and to enter a program of sustainable farm production and forest management.

The proposed principles for such a scheme (Attachment 1) aim to compensate those who maintain forest in proportion to the amount of forest they dedicate to the project. Indeed, payment to actual forest owners would represent the lion's share of the payment scheme.

However, the scheme also aims to involve all residents of the community, regardless of forest ownership, in order to build community spirit and to provide a source of on-site monitoring and peer pressure to maintain the forest resources committed to the project. As such, the principles propose an equal family payment to all families, including the "squatter" families who live in the commons. A baseline census would be required to limit participation to current residents and not permit payment to any further new arrivals.

The principles also propose payment to the community, the *Comisión Vecinal*, both for the amount of communal forest maintained and a lump sum annual payment to finance communal investment projects.

⁵ The Agrarian Reform Law (Estatuto Agrario, Ley N° 1.863/02) only requires the settler to cultivate or use the land in a rational and progressive manner, in conformity with the plan for use of the soil as established by the IBR (Article 48, para c). **Artículo 48.-** Adjudicatarios. Obligaciones. Los adjudicatarios de lotes quedan sometidos a las siguientes obligaciones: □ a) comenzar de inmediato los trabajos preparatorios para el cultivo o la utilización del lote, a partir del acto formal de posesión que le otorgue el funcionario competente del Organismo de Aplicación; □ b) construir su vivienda en el plazo de seis meses, contados a partir del momento en que se le otorgó la posesión, salvo que el mismo establezca su residencia en el casco urbano del asentamiento, conforme a lo establecido la presente ley; □ c) cultivar o utilizar el lote en forma racional y progresiva, de conformidad al plan de uso del suelo establecido por el Organismo de Aplicación y las disposiciones de esta ley; y abonar los pagos del lote solicitado dentro de los plazos establecidos en la resolución de adjudicación respectiva, de conformidad a lo establecido en la presente ley.

The cost of such a scheme will depend on the rate of participation in the project. Ideally, all the settlers would elect to participate, although this may be unrealistic given that some are reported to be engaged in the wood processing business (a small sawmill which processes wood from the settlement clearings and, perhaps, some illegal logging).

The following table assumes full participation of all settlers and of all communally held forest resources, namely, 234 hectares of private forest and 63 hectares of communal forest, including the estimated 6 hectares of forest on the two public service lots. Lower participation rates would, of course, result in lower costs.

The main variable is the compensation per hectare of high forest, for which alternative scenarios are shown at rates of \$120, \$150, \$180 and \$210. In view of the previously discussed reservation price and opportunity cost, the negotiated price would probably fall within the \$150 to \$180 range.

Other assumptions include a \$45 basic payment to each family. This is equivalent to about Gs. 200,000 per annum, an amount that is probably attractive enough to engage non-forest owners in project participation. Second, payment to owners of “low” forest and to those willing to engage in reforestation is set at one-half of the “high” forest rate, due to the lower carbon content of such forests. Third, a lump sum payment to the community for community investment projects is set at \$10,000 per annum.

La Amistad - Payment for Environmental Services
(alternative cost scenarios)

Basic payment to each family	\$45	\$45	\$45	\$45
Payment for high "gallery" forest (per ha.)	\$120	\$150	\$180	\$210
Payment for low forest & reforestation (per ha.)	\$60	\$75	\$90	\$105
Payment to families (107)	4,815	4,815	4,815	4,815
Payment to community for common forest	7,560	9,450	11,340	13,230
Payment to community for communal investment	10,000	10,000	10,000	10,000
Payment to private forest owners	28,680	35,850	43,020	50,190
Total payments (US\$)	51,055	60,115	69,175	78,235
Cost of technical assistance	25,000	25,000	25,000	25,000
Total cost (US\$)	76,055	85,115	94,175	103,235

Under the above assumptions, total payments to settlers and the community range from \$51,000 to \$78,000. A central probability estimate would be \$65,000 (resulting from a \$165 price per hectare for high forest – not shown, but equal to the average of the \$150 and \$180 per hectare scenarios).

The details of the above calculations are provided in Attachment 2, and an Excel worksheet for recalculating costs using other assumptions is provided as Annex 2.

The total cost will depend greatly on whether the project will provide technical assistance to the settlers. A full-time technician is likely to cost \$25,000 per annum, including transport, housing and supplies (Guyra estimate). Perhaps such technical assistance could be limited to the first 5 years of the project, instead of the full 20 years of project life.

Even so, the provision of technical assistance will create moral hazard by raising the opportunity cost of not clearing more forest and expanding agricultural production. As the

opportunity cost rises of not planting more sesame, for example, so too will the risk of settlers opting out of the project during project life.

The risks, benefits and cost of providing technical assistance is thus a key variable to be considered in finalizing the structure of the project and preparing a proposal to negotiate with the community.

End of text

Principles for Payment for Environmental Services in La Amistad

reproduced from prior report,
“Land use Trends in San Rafael Resource Management Area”

Key elements for a balanced incentive scheme for sustainable forest management would include:

- i. Individual payments to settlers in proportion to the amount of forest they agree to maintain, since those with more forest would be sacrificing more than others who have already cleared their lands. These individual payments would need to reflect the opportunity cost of foregoing additional cash crop income, less the out-of-pocket cost of clearing the land (if any).
- ii. Individual payments to those who agree to reforest their land, in proportion to the area reforested and in relation to the amount of reforested biomass production vis-à-vis the biomass associated with maintenance of original forest (point i).
- iii. Payments to the community for maintaining pre-agreed targets concerning the density of forest cover and biomass. Community compensation would create a sense of community responsibility and moral pressure on all residents to participate in the program (e.g., by monitoring against illegal logging by others) and to avoid violating the norms (e.g., by not entering the San Rafael Reserve to prevent degradation). Community compensation could take several forms, e.g., i) payment to the Comisión Vecinal to finance community level projects, such as local road maintenance, installation or maintenance of a potable water scheme, or community based production projects, and ii) equal direct payments to all families in the community, so that all would gain some direct monetary benefit, even those without individual forest to be maintained or land to be reforested.
- iv. The provision of intensive technical assistance to improve agricultural productivity and raise farm incomes as an alternative to the expansion of existing low-productivity farming methods.
- v. The agreement on a sustainable level of wood off-take from both La Amistad and the San Rafael areas. The idea is not to prevent all use of the forest resource, rather to promote sustainable use consistent with the regeneration capacity of the forest.
- vi. Timely payment of compensation in a manner that will closely link payment with the successful completion of semi-annual or annual verification of project goals.

The amount and form of each type of compensation would need to be calibrated to the total amount of resources available to pay for these environmental services. They would also need to be discussed and agreed with the community.

Attachment 2

LA AMISTAD - Distribución del Pago por Servicios Ambientales (PES)

Parámetros

Número de hectareas de bosque	alto , total	287
privado (80 colonos originales)	est. mar 2010	224 a/
comunales (PUs + reserva)	est. mar 2010	63 a/
Número de hectareas de bosque	bajo , total	10
privado (80 colonos originales)	est. Mar 2010	10
comunales (PUs + reserva)		0
Número de hectareas de	pastizal , total	435
Número de hectareas	a ser reforestado (est.)	20
<i>a/ 230 has. De bosque alto "dentro de las fincas" menos 6 has. perteneciendo a los PUs</i>		
Número de familias, total (según encuesta, ago 2009)		107

Pago por unidad (anualmente)

Pago básico	por familia (uniforme a todas)	\$45	211,500
Pago por hectárea de bosque	alto	\$180	846,000
Pago por hectárea de bosque	bajo (1/2 bosque alto)	\$90	423,000
Pago por hectárea de	reforestación	\$90	423,000

Guaranies
4,700
per USD

Distribución del Pago

A. Pago a las	familias	\$4,815	22,630,500
B. Pago a la	Comunidad (Comisión Vecinal)		
B1. por mantener bosques comunales			
	bosque alto	\$11,340	53,298,000
	bosque bajo	\$0	0
B2. para inversiones comunales (monto fijo)		\$10,000	47,000,000
	total, Comunidad	\$21,340	100,298,000
C. Pago a	Propietarios por mantener sus bosques		
	bosque alto	\$40,320	189,504,000
	bosque bajo	\$900	4,230,000
	reforestación	\$1,800	8,460,000
	total, Propietarios	\$43,020	202,194,000
Pago Total, La Amistad		\$69,175	325,122,500
Memo: Costo anual de asistencia técnica		\$25,000	117,500,000
(mejorar productividad, asesorar manejo de bosque sostenible, diseño de proyectos de inversión comunitarios, etc.)			
Costo Total		\$94,175	442,622,500

Scenarios Alternativos

Pago por unidad (anualmente)

Pago básico por familia (uniforme a todas)	\$45	\$45	\$45
Pago por hectárea de bosque	alto	\$120	\$150
Pago por hectárea de bosque	bajo (1/2)	\$60	\$75
Pago por hectárea de	reforestación	\$60	\$75
			\$105

Distribución del Pago

A. Pago a las	familias	\$4,815	\$4,815	\$4,815
B. Pago a la	Comunidad (Comisión Vecinal)			
B1. por mantener bosques comunales				
	bosque alto	\$7,560	\$9,450	\$13,230
	bosque bajo	\$0	\$0	\$0
B2. fondo de inversiones comunales (monto fijo)		\$10,000	\$10,000	\$10,000
	total, Comunidad	\$17,560	\$19,450	\$23,230
C. Pago a	Propietarios por mantener sus bosques			
	bosque alto	\$26,880	\$33,600	\$47,040
	bosque bajo	\$600	\$750	\$1,050
	reforestación	\$1,200	\$1,500	\$2,100
	total, Propietarios	\$28,680	\$35,850	\$50,190
Pago Total, La Amistad		\$51,055	\$60,115	\$78,235
Memo: Costo anual de asistencia técnica		\$25,000	\$25,000	\$25,000
Costo Total		\$76,055	\$85,115	\$103,235