SUSTAINABLE INTEGRATED BUSINESS PROJECT

COCOA PRODUCTIVE CHAIN

Investments Opportunities in Cocoa Production in the São Francisco and Parnaíba Valleys

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COCOA PRODUCTIVE CHAIN: INVESTMENT OPPORTUNITIES IN COCOA PRODUCTION IN THE SÃO FRANCISCO AND PARNAÍBA VALLEYS

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Executive Summary

This report presents a financial viability analysis as a result of the Agro-Industrial Productive System quality study and the pre-processing of cocoa bean for the São Francisco Valley. There is also a brief world and national market analysis, a production description, and pre-processing steps for the São Francisco Valley. During this study, it was realized that the cocoa production in this semi-arid region, in spite of actual rainfall, offers larger and faster plant development than traditional areas such as Ilhéus and Itabuna. Another fact that has made cocoa producers from the surroundings of CODEVASF enthusiastic is that the productivity can be five times larger than in those traditional production areas, in the south of Bahia, that were devastated by the "witch´s broom" disease (*Crinipellis perniciosa*). Production is expected to reach up to 4.5 tons of cocoa per hectare, whereas in traditional areas it is not even 0.75 ton/ha. In order to obtain these results, producers are using new technologies, such as ferti-irrigation—using drip irrigation associated with fertilizing. For the project development, a production of 3.0 ton/ha and one harvest per year were used as a base reference. That is because the expected real productivity is still under research and has not been consolidated yet. Two production scenarios were adopted, one for small producers with 4 ha, and another for larger producers, over 100 ha. The proposed model aims at the entire selling of the production to the Anchor Company, which will process the cocoa beans and produce by-products such as butter, liquor, and powder. The financial viability analysis has considered a 12-year term, due to the lack of studies proving the life span of coca trees in the semi-arid environment. The result from all investments, costs, and expenditures, on both production and pre-processing, have been consolidated to an Internal Results Rate (TIR) of 16% for 4-ha areas and 10% for 100-ha areas. The Investment Return Term (TRC) is 6.6 and 6.8 years for 4- and 100-ha areas, respectively.

Summary

1. PENSA and CODEVASF

CODEVASF (São Francisco and Parnaíba Valleys Development Company) is a public office, related to the National Integration Ministry of the Brazilian Government, which aims at developing the northeastern region through irrigated agriculture. CODEVASF acts in the states of Alagoas, Bahia, Minas Gerais, Pernambuco, and Sergipe, in an area of 640,000 km² of the valley, on the upper, lower, and middle São Francisco River. According to Federal law 9.954, from January 6, 2000, CODEVASF started acting also on the Parnaíba Valley, in an area of 340,000 km², covering the states of Maranhão and Piauí.

PENSA (Agribusiness Knowledge Center from the University of São Paulo) is an organization that gathers professors and researchers from economics and business departments of the Faculty of Economy and Business of the University of São Paulo (São Paulo and Ribeirão Preto). Its goal is to promote studies related to Brazilin agribusiness.

PENSA has been invited to study the viability of the implementation of complete agro-industrial systems in the area covered by CODEVASF. The study has been made for pineapple, apiculture, poultry, banana, bio-energy, caprine and ovine farming, dried fruits, orange, lime, fish, and semi-processed vegetables.

The project goal is to attract food and fiber companies well established in the national and international markets and to have the producers in the irrigated public areas as their suppliers. In order to do so, the Integrated Project of Sustainable Business was established, in which the “P” of project stands for the technical, economic, and financial viability analysis developed for the applying companies; the “I” stands for private mechanisms of contracts and relationships between agro industries and small producers that are recommended; the “B” stands for the calculated and desirable profit rates for the anchor agro-industries, as well as the desirable income for the small producers; and, finally, the “S” stands for the social, environmental, and economic aspects that should be evident.

The goals, as pointed out by the company, are the “creation of labor and income, reduction of migratory flux due to economic and social effects of the frequent draught and flood, and also the preservation of the natural resources of the São Francisco and Parnaíba rivers for the better quality of life of the people living in those areas.” For that purpose, CODEVASF is organized regionally and divided into seven administration offices, called regional offices, acting on the middle, sub-middle, and lower São Francisco River. In the middle São Francisco are located the Montes Claros (Minas Gerais) regional office (1st regional office) and the Bom Jesus da Lapa (Bahia) regional office (2nd regional office). In Montes Claros, local productive arrangements have been developed for apiculture and for ovine and fish farming; this area is the productive “stand–out” of the Jaiba Project, with irrigated fruit culture, mainly banana, lime, and mango. In Bom Jesus da Lapa, the projects are primarily at Baixio do Irecê, Barreiras do Norte, Barreiras do Sul, Estreito, and Formoso. In those areas, the most prominent is the irrigated fruit culture, especially banana and mango, as well as the grain production in Barreiras do Norte. In addition, the region is also strongly developing its bioenergy potentiality through the production of ethanol and biodiesel.

In the sub-middle region of the São Francisco River Valley are located the Petrolina (Pernambuco) regional office (3rd regional office) and the Juazeiro (Bahia) regional office (6th regional office). The irrigated fruit culture is well developed in this area, mainly mango, grape, and coconut. In the lower São Francisco are the Aracaju (Sergipe) regional office (4th regional office), and the Penedo (Alagoas) regional office (5th regional office). Due to the plain topographic conditions, low altitude, and abundant water resources, the region has strongly developed the rice culture, and it is currently developing fish farming using caved tanks, producing Tambaquis (*Colossoma macropomum*) and Tilapias (*Oreochromis niloticus*) for the local markets. Finally, in the Parnaíba River Valley CODEVASF is represented by the Teresina (Piauí) regional office (7th regional office). In this region, the focus is on the management of the semi-arid areas in order to reinvigorate fauna and flora and to develop apiculture and caprine farming as sustainable economic activities.

2. Characteristics and Competitiveness of the São Francisco and Parnaíba Valleys

The São Francisco Valley occupies an area of 640,000 km^2, of which 36.8% is in Minas Gerais, 0.7% in Goiás and the Federal District, and the remaining 62.5% in the states of Bahia, Pernambuco, Sergipe, and Alagoas. The Parnaíba Valley is in the northeastern area of Brazil, covering a total area of 330,000 km^2, of which 75.73% is in Piauí, 19.02% in Maranhão, 4.35% in Ceará, and the remainder in a litigious area.

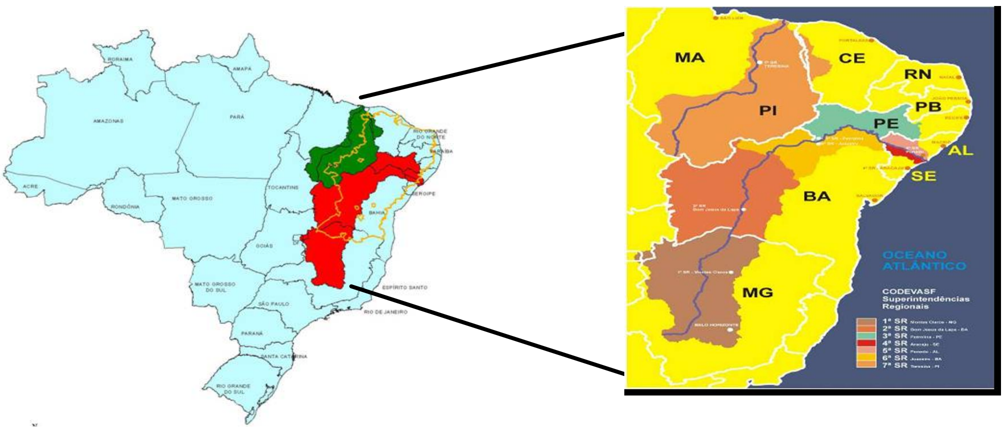


Figure 1: Locations of the São Francisco and Parnaíba Valleys.
Source: CODEVASF (2007).

The population[1] of the Petrolina and Juazeiro[2] region is about 570,000 inhabitants, with 68% living in urban areas and 32% in rural areas. Of the houses, 86% have electricity,[3] 57% have plumbing, and 85% have disposal services.

[1] Demographic census, 2000.
[2] Due the great extension covered by the São Francisco and Parnaíba valleys, the regions of Petrolina and Juazeiro were used as a reference for the presentation of the characteristics of competiveness.
[3] IPEA, 2000.

Table 1: Summary of Socioeconomic Data

City	State	Population	GDP per Capita (R$)
Petrolina	PE	218,538	5,668
Lagoa Grande	PE	19,137	5,936
Santamaria da Boa Vista	PE	36,914	5,043
Orocó	PE	10,825	6,279
Juazeiro	BA	174,567	4,347
Sobradinho	BA	21,325	13,337
Casa Nova	BA	55,730	2,382
Curaçá	BA	28,841	3,196

Source: IBGE (2008).

Regarding education, the literacy rate is 74%, life expectancy of 65 years, and infant mortality is 4.9%. In the area, there are about 37 thousand secondary school students and 7,000 at institutions of higher education. The GDP of the Petrolina and Juazeiro area is around R$3 billion, bringing the annual GDP per capita average to R$6,500.

The Petrolina and Juazeiro area is located at 8 ºS latitude, at an average height of 365 meters. The climate is semi-arid, warm and dry, with monthly rain of 44 mm concentrated on the first semester; insolation is 3,000 hours per year, with 300 days of sun. Because of this, the average monthly temperature is 26 °C, with 67% air humidity and a monthly average evaporation of 7.5 mm.

The soils in the area are plain with slight inclinations, with a minimum of 90 cm depth. At the Pontal project, soils can be Podzolics or Latosoils. At the Salitre Project, soils have poorly developed profiles and Cambisoils and Vertisoils are predominant.

At some spots in the Petrolina and Juazeiro area, an underground drainage system will have to be implanted in order to avoid soil drenching in periods of heavy rain and to reduce the risk of salinization of irrigated soils in semi-humid and semi-arid areas.

The fruit culture in the São Francisco Valley has greatly increased in the past few years. The planted area covers around 100,000 ha, including private areas and CODEVASF areas, and it has grown an average of 9,000 ha per year in the last three years.

Table 2: Fruit Production Profile in the Petrolina and Juazeiro Area

PERMANENT CULTURE		
PERMANENT CULTURE	PRODUCTION (ton)	AREA (ha)
Mango	224,000	13,256
Banana	186,060	9,083
Grape	51,560	4,363
Coconut	129,597	3,964
Guava	77,660	3,788
Papaya	10,459	521
Lime	793	101
Passion Fruit	3,859	627
Avocado	96	8
Orange	60	10

Source: Valexport (2007) and IBGE (2008).

As a reference, land cost in the Petrolina and Juazeiro area varies according to the geographic location, soil quality (natural fertility), and lot conditions. Empty land lots—that is, with no investments in irrigation equipment or current agriculture—vary between R$1,000 and R$10,000/ha.

Table 3: Data for the Investment Analysis in the Petrolina and Juazeiro Area

Item	Work force/day (field)	Empty land	Water*
Cost	R$20	Between R$1,000 and R$10,000/ha	R$71.42/ha/yr plus R$0.055/m3

Source: PENSA.
*Estimate. Water price differs from project to project.

Among the logistic options, the main ones are roads, seaports and airports. There are also railroad and river port options. For the road transportation, there are a number of roads. River ports make the grain transportation possible from west Bahia to the Petrolina and Juazeiro ports. The waterway is 1,300 km long, from Pirapora in Minas Gerais to Santa Maria da Boa Vista in Pernambuco. As a reference, the São Francisco River can be travelled for 100 km more from Petrolina and Juazeiro.

Table 4: Cost of Road Transportation and Distance from the Petrolina and Juazeiro Area

Port		Salvador	Fortaleza	Recife	Rio de Janeiro	São Paulo
Distance (km)		511	878	721	1,928	2,241
Freight R$/t	Conventional	47	64	65	160	186
	Refrigerated	56	77	78	192	223

Source: PENSA.

Regarding sea transportation, the largest ports in the northeast region are located in Salvador, Fortaleza, Recife, São Luis, and Natal. Distances are listed in the following chart:

Table 5: Distance from Petrolina and Juazeiro to the Main Northeastern Ports

Port	Salvador	Pecém (Fortaleza)	Recife	São Luis	Natal
Distance	570 km	900 km	715 km	1,200 km	850 km

Source: PENSA.

Another option is the Center Atlantic Railway that links Petrolina to the Salvador port (570 km). There is also a project (public/private partnership—PPP) to link the Trans-northeastern Road to Juazeiro, which will make the access to the Maceió, Recife, João Pessoa, Natal, Fortaleza, and São Luís ports possible and will also make the Salvador port less busy (it is estimated that the project will be concluded one year after its approval).

Petrolina International Airport is able to land most carrier planes, and due to its geographic location it allows direct flights to the U.S. and Europe, making the freight cheaper. It has an infrastructure ready to store 100,000 fruit boxes in a climate-controlled area and other structures that allow the export of perishable goods.

3. Company Cases in the Region

The objective of this topic is to present some companies in the region, in order to show success cases in the São Francisco and Parnaíba Valleys. Key company cases in the region can help the competitiveness analysis, showing the necessary business orientation for small, medium, and large producers.

Located near to Petrolina and Juazeiro, the **Suemi Special Fruit Company** is an example for fruit production and exportation. It started producing on 12 ha of land, and today it produces fruits on a 500-ha area, exporting to many countries and using European retailers and U.S. Department of Agriculture (USDA) certificates. The company relies on a large packing house, employing over 1,000 workers, and using its own brand in the international market. Its high points have been quality control and international commercial management.

The **Amacoco Company** has established itself in the Petrolina region aiming to take advantage of local coconut production for coconut water. Today, it buys coconuts from various independent producers in an area of 800 ha and has also invested in its own production areas. The greatest challenge for this company has been the establishment of a stable supply flow, since it has done an excellent job with regard to production, transportation, and product management. Coconut water has reached a good acceptance in the isotonic drink market, and it has also succeeded in food service chains. The capacity of the unit in Petrolina is 70,000 liters per day.

Agrovale is a sugar cane processing plant for sugar and alcohol production and energy co-generation. Its production is set on a 20,000-ha area, on which 1.5 million tons of sugar cane are processed every harvest. The plantation is totally irrigated, reaching a productivity of over 110 tons/ha. The semi-arid area production contradicts a paradigm by the difference of its management on an irrigated production. The plant is built on a CODEVASF project called Tourão, in the city of Juazeiro, in Bahia. All of its production is destined for supplying the state of Bahia.

An important organization in terms of the sector coordination is **Valexport—Orchard, Fruit, Poultry, and By-products Producers and Exporters** of the São Francisco Valley Association. Today, around 50 producers and exporters are Valexport associates, which represents 70% of the region's production and 80% of the exportation. The scope of actions of this organization includes common interest actions of national and international communication, processing quality, and efficiency of the existent productive chains. This factor is very important because it increases the possibility of coordinated actions and market intelligence.

One of the most fundamental organizations for the development of the Brazilian semi-arid area is **Embrapa Semi-Árido.** Created in 1975, Embrapa Semi-Arido seeks viable technological, competitive, and sustainable solutions for the agribusiness in the region, for the benefit of society. One of its essential projects is the necessary diversification of cultures in the region. Cultures such as olives, peaches, citrus, cocoa, and pear, among others, are tested and adapted. Embrapa is, today, a reference for the region as a research center and a support for producers.

Another case of a company installed in the São Francisco Valley that stands out by its market success and projection for the region is **Vinibrasil**. Creator of the idea of the project "New Latitude, New Attitude," the company has, together with other wineries in the region, built the São Francisco Valley brand. Originally from Portugal, the company has tested and developed varieties in the region, at its own farm in an area of 200 ha, with room to grow. The wines that Brazil and the world have known and appreciated include Rio Sol and Adega do Brasil.

A cooperative that brings a key example of the insertion of small producers into the agribusiness is **Pindorama**, located in the lower São Francisco River, in the city of Coruripe (Alagoas). The model was idealized by Berthlet, a French-Swiss who came in 1956 with the mission to settle families in lots, as colonies, producing on a cooperative system exclusively for sugar, alcohol, coconut by-products, passion fruit, and acerola, besides dairy cattle. This model is unique in that it allows the sustainable inclusion of small producers, and it is noticeable by making it with the sugar cane culture.

Another example of insertion of small producers into the agribusiness is the case of the partnership between **Itacitrus**, a private company for the production and distribution of lime on both internal and external markets, with **CentraJai**—Central of Project Jaíba Producers Associations. CentralJai established a partnership with Itacitrus in August 2007, aiming to expand its associate's market by selling the lime on the external market and increasing their participation in the internal market. From November 2007, almost all of CentralJai lime production for the internal market and all of it for the external market has been commercialized by Itacitrus, which became responsible, inside CentralJai, for the trading management (internal and external sales) and for the quality management (standards checking of limes for both internal and external markets).

4. Agro-Industrial System (SAG) and Attractiveness Analysis of the São Francisco and Parnaíba Valleys for the Irrigated Cocoa Culture

4.1. Cocoa Productive Chain and Commercialization

4.1.1. Cocoa Fruit

Cocoa is a noble and traditional Brazilian agricultural product that has been through a recovery process, especially in the south of Bahia and in Rondonia, after a long period of crisis from the late 1980s to the mid 1990s (ALMEIDA *et al.,* 2001).

The cocoa tree (*Theobroma cacao*) is a plant from the *Sterculiaceae* family and *Theobroma* gender, originated from the south of the American continent, that grows to a height of 4 to 12 meters. The main Brazilian species are “criolo,” *Treobroma cacao*, *Linaeus,* “forasteiro” or purple cocoa, *Treobroma leiocarpum*, and *Bern* (OETTERER *et al.,* 2006).

Cocoa flowers grow in the shape of pillows, on the trunk and branches, at a volume of over 100,000, of which only 5% are fertilized and 0.1% become fruits. Those supported by branches present various colors: from green (young) to yellow (mature), while others go from purple to orange during maturation. The fruit rate—that is, the number of fruits necessary to obtain 1 kg of commercial cocoa—is usually between 15 and 31 units (ALMEIDA *et al.,* 2001).

The fruit grows from four to six months after the blooming, and it is composed of peel, pulp, and seeds or beans. The weight/volume rate is 1:2 (500 g: 1,000 cm^3), and the peel weighs 75% of the total. Fruits are melon-size and -shape, at around 25 cm long and 10 cm wide. Inside are the beans or pod, surrounded by a white mucilaginous pulp, with 80% humidity and 15% monosaccharide (OETTERER *et al.,* 2006).

4.1.2 Cocoa Market

The seed is the main product commercialized by producers and, in order to get the commercial value from it, processing is necessary. Processing consists of the fermentation of the fruit on the field and the posterior drying. The fruit beans harvested are purple, of bitter taste and astringent odor, and they have no commercial value until dried. Only after being “cured” can cocoa be valuable to industry and exportable, because after curing it acquires its typical brown color, taste, and odor (OETTERER *et al,* 2006).

The cocoa market in Bahia is composed of a great number of medium and large producers, small and large intermediaries, and a small number of cocoa processing facilities. The final product is homogenous at the primary level (cocoa beans), as well as at the processed level (cocoa butter, liquor, etc.)

The trading channels in the cocoa production region in Bahia are composed of four rings. The first is represented by the production units, the second by the intermediary agents, the third by the bean processing industries, and the fourth by the country’s chocolate industry and the by-product sales on the external market.

Local producers sell the cocoa to resellers, medium and large intermediaries (second ring in the trading flow), which do not process the product, and bean-processing industries, which represent the third ring in the flow. The resellers are small intermediaries in the informal market that buy small amounts of beans and that, later, trade with other intermediaries. Medium and large intermediaries have trading offices in the main cocoa producing cities and are more capitalized compared with the resellers, and thus they have more negotiation power over producers.

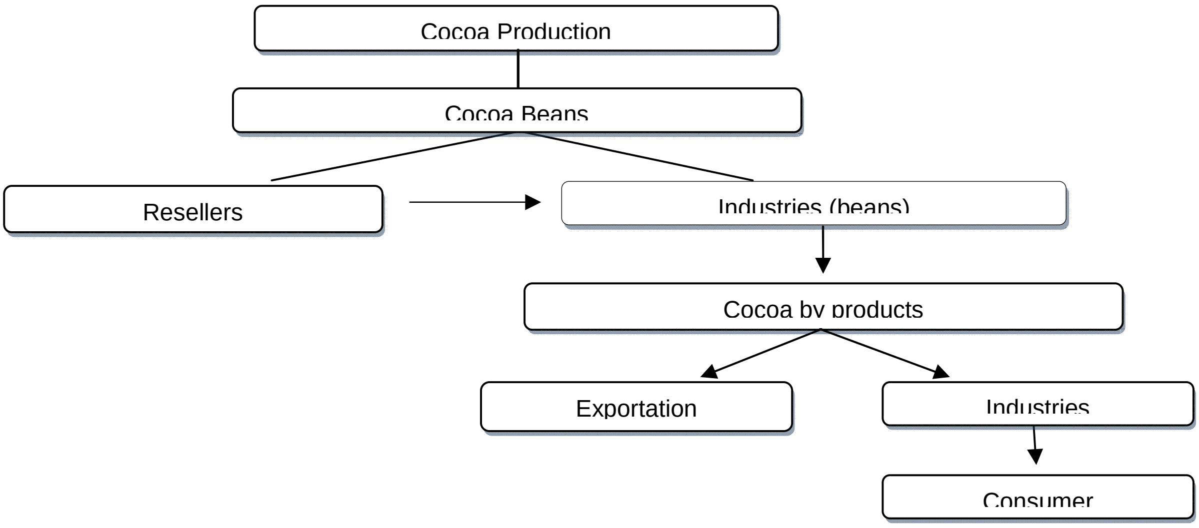


Figure 2: Cocoa trading channels in the cocoa production region of Bahia.
Adaptaded from GOMES *et al.* (2008).

In some cases, intermediaries advance the capital to the resellers, establishing an informal trading agreement. Normally, the purchase is done directly at the production units, thus transferring transportation costs to the intermediary. Producers that sell directly to the industries have, in general, a large amount of beans. In the city of Ilheus, there are only bean-processing units. The production of cocoa by-products occurs in other locations, mainly in the southeast part of the country.

With the cocoa activity crisis and, consequently, the regional production reduction, Brazilian processing industries started to import, from 1997—mainly from Africa—cocoa beans to supply internal demand from ground units in the Ilheus industrial district.

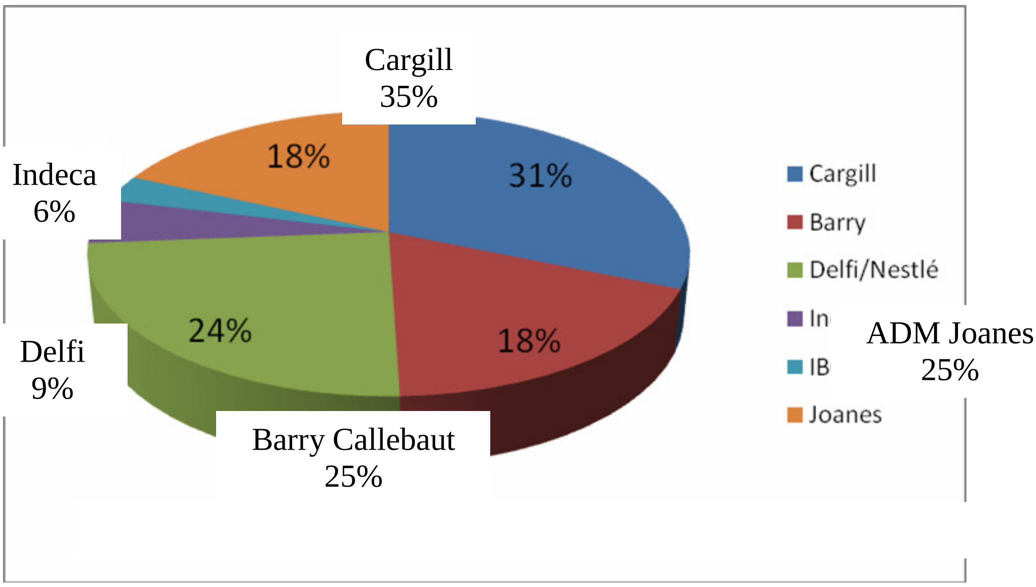
Cocoa processing industries are divided into two categories: cocoa bean processing industries and the chocolate industry. Bean grounding industries are large, multinational companies with a high production capacity, as seen in Table 6.

Company	Consume (Thousands of ton)	Share
Archer Daniels Midland (ADM)	470	15%
Cargill	440	14%
Barry Callebaut	400	13%
Blommer	170	5%
Petra Foods	160	5%
Nestlé	150	5%
Cadbury	100	3%
Cantalou/Cemoi	90	3%
Hershey Co.	70	2%
Ferrero	70	2%
Schwarteuer Werke (KVB)	60	2%
Philip Morris/KJS	60	2%
Schokinag	60	2%
Mars	50	2%
Others	850	27%
Total	**3,200**	**100%**

Table 6: Main Cocoa Processing Companies of 2003/04
Source: Adapted from ICCO, 2007.

The two main companies in 2009 (Barry Callebaut and Delphi) are responsible for over 40% of all cocoa beans produced in Brazil, as seen in the graphic below.

Figure 1. Cocoa processing industries share in Brazil; 2009.



Source: TH Consultoria e Estudos de Mercado Ltda.

Products obtained from the transformation industry can be commercialized with chocolate and cosmetics[1] industries or exporters. Chocolate industries are part of a fairly concentrated market, since only ten companies are responsible for 40% of the world's chocolate sales, as seen in Table 7.

Rank	Company	Total Chocolate Sales in 2005 ($ million)
1	Nestlé SA	6,935.5
2	Ferrero SA	5,554.8
3	Cadbury Schweppes PLC	4,183.6
4	Mars Inc. / Masterfoods	3,321.6
5	Hershey Foods Corp.	3,143.4
6	Kraft Foods Inc.	2,489.0
7	Lindt & Sprüngli	1,803.6
8	Barry Callebaut AG	1,008.2
9	Meiji Seika Kaisha Ltd.	724.7
10	Russell Stover Candies, Inc.	426.3
	Total	**68,100.00**

Table 7. Main Chocolate Producers in 2005
Source: ICCO, 2007.

The chocolate industry has proven to be dynamic in the last few years, since it has overcome tough barriers representing a real threat to the chocolate products industry and has reacted to consumption changes such as worries about health and the high level of obesity. The industry has reacted through the development of new products, responding to a demand for healthier products, as well as chocolates with a high level of cocoa and premium chocolates (ICCO, 2007).

4.2. Cocoa Production

The cocoa tree is a perennial plant, and its productive cycle can reach over 100 years, with a productive ideal of 35 years. The economic production starts in the fifth year after the planting, and it develops on grounds with different characteristics and fertility levels such as forest, bushes, or grass fields. Since it is, typically, a tropical humid plant, the ideal soil and climate conditions for the cocoa tree are a medium/high–fertility soil, well drained, and at depths of 1.5 m, along with a stable climate, with low variations of temperature, solar exposure, and day length (ALMEIDA *et al.,* 2001).

In the traditional areas of cocoa production, during the culture formation, two types of shading are implemented: temporary and definitive. For the temporary shading, banana trees are usually used to protect the plants from light and wind excesses, and they also represent a source of income during the first years, as the cocoa production returns the first incomes from the third year on. The definitive shading is implemented at the same time as the temporary, with bigger plants such as *eritrina* (*E.falcata), ingazeira (Inga sp.), Mahogany (Swietenia macrophylla), cedro (Cedrala fissilis), Brazil Nut (Bertholletia excelsa) and jatobá (Hymenaea courbaril).* Now, however, in the irrigated cocoa culture, the definitive shading has not been used because production unshaded from the sun has become more attractive.

For the cocoa production in non-traditional areas, it is necessary that the water be supplied through an irrigation system. These regions have a precipitation rate at 600 to 800 mm per year, distributed from December to March, while the cocoa tree needs 100 to 150 mm monthly in order to produce well (Gramacho et al., 1992 apud MI, 2006). Besides water, there is the need for macro- and micro-nutrient supplies, via irrigation water, to nurture the plants in order for them to fully express their genetics potential and be resistant to infections and diseases (MI, 2006).

Another technology that allows the anticipation of production in the region is the use of planting of rooted branches (produced in tubes and transplanted to plastic bags). Cocoa trees originating from these type of branches tend to produce earlier (Marrocos et al., 2003 apud MI, 2006).

Cocoa production activity is related, in general, to the following steps: (1) cocoa production, from the soil preparation and culture implementation until the production of dry cocoa beans; (2) commercializing, related to the dry beans trading until the transportation to the cocoa transformation industries; (3) cocoa processing; and (4) commercializing of the products after the cocoa processing (GOMES *et al*, 2008).

4.2.1. World Production

Cocoa world production in 2006, according to the Food and Agriculture Organization (FAO), was 4,058 thousand tons, while the Brazilian production was only about 200,000 tons. The main producer was Ivory Coast, with 34.5% of the world's production, or 1,400 thousand tons, followed by Ghana (18.1%), Indonesia (14.3%), Nigeria (11.9%), and Brazil (4.9%).

Countries	**Production (thousand tons) 06/07**	**Production (thousand tons) 08/09**
Ivory Coast	1,400	1,210
Ghana	734	660
Indonesia	580	485
Nigeria	485	220
Brazil	199	145
Cameroon	164	210
World production	4,058	***

Table 8. Cocoa Beans World Production (thousands of tons)
Source: PENSA based FAO data (2008) **and TH Consult (2009).**

4.2.2. National Production

Cocoa production in Brazil is concentrated in the south of Bahia. In 2004, production in Bahia was 136,155 tons, followed by Para and Rondonia with 32,804 tons and 18,592 tons, respectively (IBGE: 2006). Bahia's share of the national production has decreased in recent years, while that of the states in the Amazon area has increased. In 1990, Bahia, Para, and Rondonia corresponded to 83%, 8% and 5.7% of the total, respectively, which went to 69%, 17% and 9% in 2004. According to the TH Consultant, in the harvest of 08/09 the Bahia produced 99.7

thousand tons of cacao, while the other regions produced 56 thousand tons, of which 86% was from the state of Pará and 6.4% from Espírito Santo. That shows a new production geography, which is moving from the traditional axis (south of Bahia) toward the Amazon area (especially Para and Rondonia) (GOMES, PIRES, FRERE, 2006).

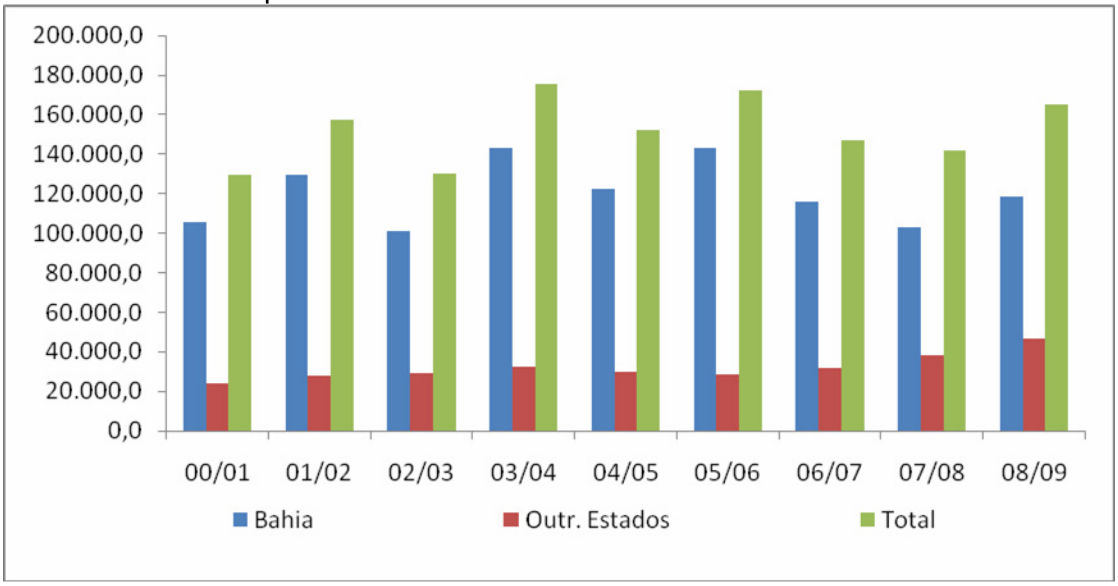
With regard to productivity, the advantages of the Amazon area are evident. While the State of Bahia is experiencing a steady decrease in productivity levels, at around 55% between 1990 and 2004 (on average, from 0,540 tons/ha to 0,240 tons/ha), the States of Para and Rondonia (on average from 0,495 tons/ha to 0,645 tons/ha) have increased consecutively (10% and 30% during the same period) (GOMES, PIRES, FREIRE, 2006).

Another important factor is that the States of Para and Rondonia present an agricultural structure based, mainly, on family production units, which are more compatible with the land-distribution objectives in the country, which are different from Bahia. Another advantage of the area is related to the lower levels of debt of cocoa producers compared with those in Bahia (GOMES, PIRES, FREIRE, 2006).

The advantages related to the south of Bahia are associated with the infra-structure for the cocoa bean commercialization and the existence, in the region, of processing industries.

Brazilian cocoa production evolution, considering FAO data from 200 to 2006, can be seen in Fig. 2. One should note an oscillation during the period, as a result of the effect of the Witch Broom disease on the biggest production area of the country, Bahia, in addition to the advanced age of the trees in this region, making the production unstable.

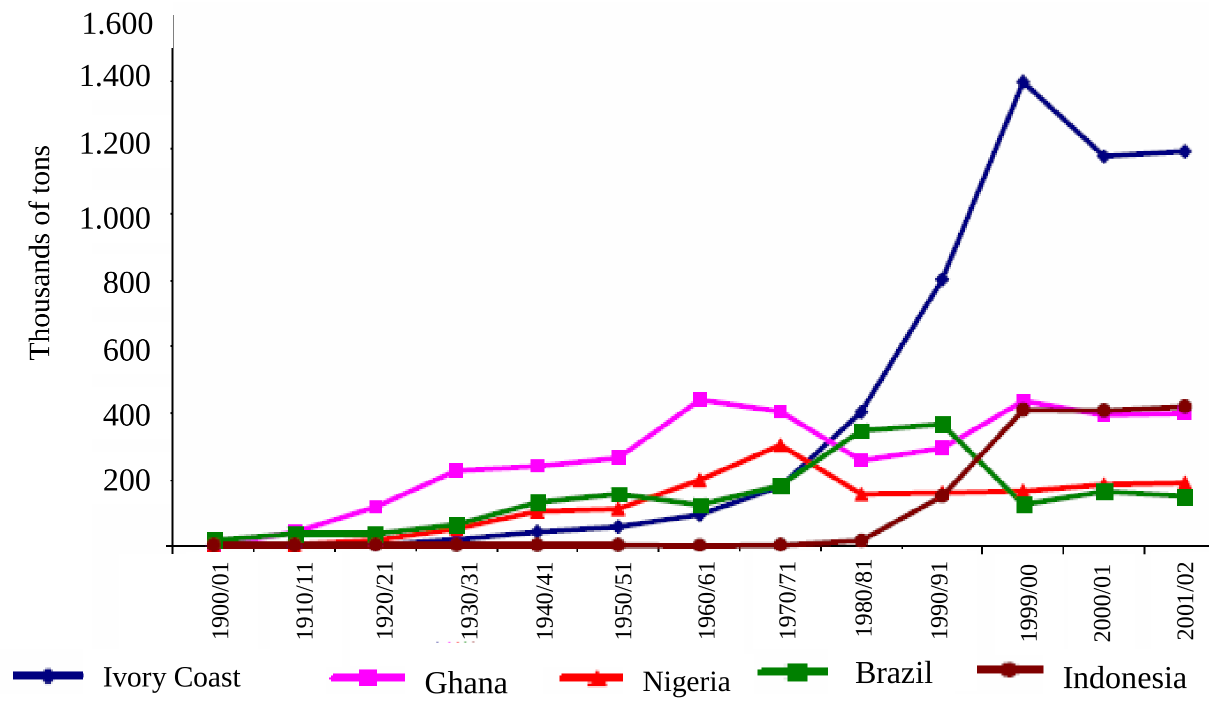
Figure 2. Brazilian cocoa production evolution in tons.



Source: PENSA based on Associação Comercial da Bahia.

Brazil held second place in the world cocoa production until the 1980s. At the peak, it reached 400,000 tons per year and a leadership in productivity at 750 kg/ha. At the time, Brazil was only behind Ivory Coast, which has led the world in production since the 1960s (CANTALINO, 2006).

Figure 3. Cocoa bean production of main producing countries from 1900/01 to 2001/02.



Source: CANTALINO, 2006.

From 2003 on, a production recovery can be noted, and one can conclude that this productivity improvement was a result of the harvest of clones planted after the problems with witch broom in 1999.

The main cocoa bean buyers are the ground companies. Grounding is distributed among several countries, including Brazil, the biggest cocoa processing country in Latin America. Holland is the world's main grounding country, with 445,000 tons, which is equivalent to 14% of world groundings. Next is the U.S., with 410,000 tons, Ivory Coast with 305,000 tons, Malaysia and Indonesia with 300,000 tons, Germany with 224,000 tons, and Brazil, ranking 6th, with 202,000 tons (CANTALINO, 2006).

According to TH Consult, the world market deficit from the harvest of 2007/08 was 60,000 tons, and it was estimated to be 84,000 tons in 08/09. According to ZUGAIB (2008), world stocks decreased from 1,682,000 tons in 2003/04 to 1,536,000 tons in 2007/08. Deficits of the international market have been larger than surpluses during the period between 1990/91 and 2007/08, and that has contributed to the fact that the number of months that world stocks are available for processing companies has decreased from 8.6 months to 4.9 months.

The price of 0,015 tons of cocoa has been increasing significantly during the last three years. The price of cocoa in June 2006 was around US$ 256 per ton, while in June 2008 the price had reached an average of US$ 40,23.

4.3 Processing

Cocoa processing and storage are activities that aim toward the preparation of the product for its commercialization and the preservation of its quality characteristics until it reaches the final consumer (MI, 2005).

Initially, the fruit is harvested with machetes and gathered on the ground to be opened (OETTERER *et al.*, 2006). The period between the harvesting and the opening should not be longer than 5 days, in order to reduce germinating problems and breakage (MI, 2005) (Figures 4 and 5).

The peel is separated and the internal material (beans and pulp) is put in wooden boxes to be cured (OETTERER *et al.*, 2006) (Figure 4). During the process, the boxes are covered with banana leaves to reduce heat loss and to avoid excessive dryness of the superficial layer. (BECKETT, 1988).

Fermentation process takes, in average, six days, with big micro-biotic alterations in the various phases, varying temperature and pH on the mass. In the first 36 hours, predominantly the yeast multiplies and the fermentation begins with the conversion of sugar into ethylic alcohol, the decomposing of citric acid, a temperature elevation, and the formation of an exudate that can be observed (Ardhana, 2003, *apud* SANTANA, 2008). During the fermenting, chemical substances are formed that contribute, especially, to the process of developing the peculiar characteristics such as the flavor, odor, and color of the chocolate (MI, 2005).

The development of micro-organisms that take part in this phase is benefitted by the mucilaginous pulp surrounding the cocoa seeds, which is, in general, characterized by having 80–90% water, 10–13% sugar, and a pH of 3.5–3.6. This, associated with low oxygen availability due to the compact mass formed in the interior of the fermenting boxes, provides an excellent environment for the development of yeast, which will multiply quickly and be responsible for the initial alcoholic fermentation.

A healthy cocoa pulp is micro-organism free, but it is contaminated immediately when the fruits are opened manually by the workers and also later when exposed to the environment. The micro-biotic activity triggers a temperature increase in the mass, neutralizing the germinative power of the seed. Those are the proper conditions for the chemical reactions that will affect flavor and odor (BECKETT, 1988).

The fermenting boxes should be wooden in order to prevent other odors from contaminating the product, and the boxes should have drains to separate out the syrup and facilitate the airing of the mass. Those drains are 6–10-mm-diameter holes in the bottom, spaced 15 cm by 15 cm. A more efficient draining, with a possible reduction in time of 1 to 2 days, can be achieved by building the bottom with a 5-cm-wide structure, spaced 5 cm between poles. Traditional boxes are usually made with pieces of two or more compartments 1.2 m wide, 1 m high, and 1 m long, with a capacity of 900 kg of fresh seeds each (MI, 2005).

Cocoa can also be fermented in smaller boxes, which are more convenient to smaller properties. In this case, wooden boxes of 0.7 m by 0.7 m, minimum, are used, with drains and a capacity of 200 kg of humid cocoa (MI, 2005) (Fig. 6).

The revolving is to provide airing and uniformization of the cocoa mass. It can start on the second day of fermenting and is done daily until the end of the process, which can last 5 to 7 days. Once the desired fermentation degree is reached, cocoa presents an external coloration of an intense brown, and a vinegar-like aroma. Internally, one can observe an also brown-colored liquid that exudates easily when the seeds are pressed.

Drying is the processing stage, in which the water excess of the recently fermented cocoa is eliminated, reducing the initial humidity of 50–55% to 7–8%, in order to guarantee its conservation during storage and reduce the acidity (MI, 2005) (Figure 7).

Traditional drying is done right after the fermentation on standard trays of 3 x 6 m, 8 x 8 m, and 6 x 12 m, on which the beans are exposed to the sun and revolved with wooden squeegees to prevent bean agglomeration and achieve a more homogenous drying. Artificial drying can also be adopted with the use of hot-air tunnels, though this system requires a large investment and can make small production unviable (OETTERER *et al.,* 2006). The irrigated areas in the São Francisco Valley present a high level of luminosity and low air humidity, making the sun drying of cocoa beans efficient.

On the trays, cocoa is spread in layers of 3–6 mm thick, depending on the harvesting flow and climate conditions. This represents a load of 25 kg to 40 kg of humid cocoa per square meter. According to the National Integration Ministry (2005), the approximate cost of a tray is US$17,171.00.

After it is dried, the cocoa should be bagged, up to 60 kg per bag, and stored in a compartment with wood flooring and covered walls or on a wooden bed (MI, 2005). Bean storage must be done in a maximum 70% humidity environment, and the temperature should not exceed the environment temperature, in order to avoid fungus on the cocoa beans. The storage rooms should not contain other products because cocoa beans are highly capable of absorbing other external odors (OETTERER, 2006).

Figure 4. Opening of fruit to collect beans.

Source: FAPESP, 2006.

Figure 5. Opening is done on the site of harvesting.

Source: FAPESP, 2006.

Figure 6. Beans ready for fermenting.

Source: FAPESP, 2006.

Figure 7. Drying on the trays.

Source: FAPESP, 2006.

5. Investment Opportunities in Cocoa Production in the São Francisco and Parnaíba Valleys

5.1 Cocoa Production on the Perimeters of São Francisco Valley

The expansion of the agricultural frontiers in Brazil is a reality, especially with fruits and grains. The most remarkable cases are the grape culture in the semi-arid region and the soy bean culture in almost the whole country. Cultures such as cocoa, however, are limited to micro-climate areas in the Amazon (including the States of Amazonas, Rondonia, Para, and Mato Grosso) and to regions in the south of Bahia and the north of Espirito Santo (Alvim, 1975; Alvim, 1978; Alvim, 1993 *apud* MI, 2006).

On the other hand, with the improvement of technologies related to agricultural production in the last few years, it is possible to implement the culture successfully in non-traditional areas—due, especially, to new irrigation, ferti-irrigation, and management techniques, as well as genetic improvements.

According to LEITE (2006), the possibility to expand the cocoa culture to non-traditional areas is more than a paradigm shift. It can generate incomes for the country by reducing the importation, and it might even allow the country to regain its position as an exporter. In addition, it can create jobs and income for communities in need in the Brazilian semi-arid region. Several producers, isolated and independent, have been experimenting with cocoa culture in small areas, sometimes just out of curiosity. This practice is seen in the semi-arid areas of Jequié, Jequitinhonha, Ibotirama, Barreiras, Bom Jesus da Lapa, and Juazeiro/Petrolina.

5.2. Attractiveness of the São Francisco and Parnaíba Valleys for Cocoa Production

Irrigated cocoa production is highly productive and not likely to develop diseases, since the climate in the irrigated areas is extremely dry with low precipitation.

Regions of the semi-arid area, especially the perimeters of the São Francisco River Valley, present a climate with 600–800 mm/year of precipitation, concentrated in the December-to-March period, air humidity of 40–50%, high luminosity, and fertile soils (Seixas, 2004 *apud* MI, 2006). These conditions, associated with the ferti-irrigation and a distinct management, can lead cocoa production in the area to success. In addition, the area could represent an end for the main diseases affecting cocoa, making it favorable for the processing and quality of seeds.

The Formoso area, located in the city of Bom Jesus da Lapa (Bahia, 796 km from Salvador and 660 km from Brasilia), already has a total area of 48 ha producing cocoa. Producers in the area purchased young cocoa plants three years ago, and since then they have been conducting managing experiments with different spacing between plants, number of banana plants for shading, and the use of nine different clones of cocoa.

5.3. Business Introduction

The business model consists of the irrigated cocoa production together with banana. The model also proposes the forming of a cooperative among producers in order to create a sufficient volume of cocoa beans and to commercialize with the processing industries. In the next subsection, the proposed business model will be described, as well as characterized through the main results found.

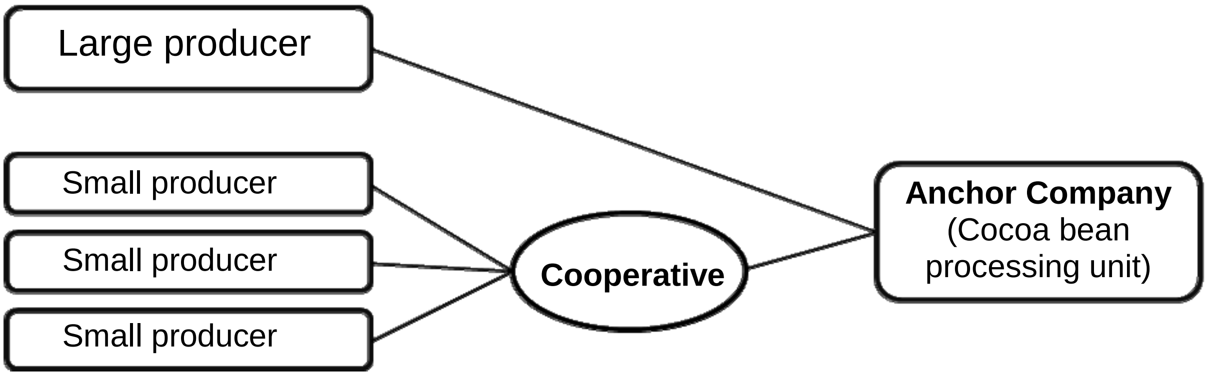
The business model proposes three cocoa production models: one-hectare production for those producers still suspicious of other cultures, four-hectare production for family lots, and a 100-hectare model for entrepreneurial lots.

5.4. Business Model

The business model proposed consists of a partnership in which an anchor company can buy all production of the cocoa producers in the irrigated areas. In this model, there will be a cooperative of producers, the role of which will be to intermediate between the small producers and the anchor company.

Figure 8 presents a cocoa productive chain structure and the agents involved in the process. The chain structure more and more regards the economic development process as independent from other productive segments of the economy.

Figure 8. Cocoa chain.



Source: PENSA.

The cocoa agro-industrial chain is seen as a coordination of organizations, resources, and rules regarding input acquisitions, cocoa production, processing, and final products distribution, where every agent involved should meet their commitments for the good development of the process; that is:

Producers	Cooperative	Anchor Company
• Adopt the proper management for the correct fermentation and drying of cocoa beans • Sell the agreed share to the cooperative	• Purchase a volume sufficient to commercialize with processing companies • Assist producers on culture managing and processing elaboration	• Buy and transport the agreed production • Have fair prices • Assist producers by promoting capacitating and training

Table 9. Responsibilities of Agents Involved in the Cocoa Chain

5.5. Economic Viability Analysis

The production cost analysis was developed after information was collected from irrigated cocoa producers and consultant companies, in addition to the Agrianual data.

The initial investment in a cocoa plantation is for the land, the irrigation system implementation, and the building of the drying tray and the fermentation boxes. The total investment for a 4-ha lot is approximately US$33,490.00

Investments 4 há			
Description	**Amount**	**Price**	**Total**
Land (per ha)	4	US$ 930,360	US$ 3723,413
Irrigation system	4	US$ 3,141,361	US$ 12,565,445
Kit (tray, boxes)	1	US$ 17,207	US$ 17,207,382
Total		US$ 21,279	US$ 33,496,240

Table 10. Initial Investment Data for Cocoa Production

Next is presented the cocoa production costs, production estimate, and the average cocoa price per 0,015 tons. Though the production estimative per hectare is considered 3.0 tons, it can reach, according to researchers, 6.0 tons per hectare. On the other hand, there is also an uncertainty regarding the real cocoa responding to the irrigation process. Some say that in some cases the productivity has decreased. The final answer will only come in time.

Costs per ha								
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8 to 12**
Estimate production (@/ha)			**40**	**120**	**200**	**200**	**200**	**200**
Costs	24,750	2173,068	2557,151	2643,539	2643,539	2643,539	2533,102	2530,450
Cocoa average price (US$/@)	31,413	31,413	31,413	31,413	31,413	31,413	31,413	31,413
Incomes	0.00	0.00	1257,861	3773,584	6289,308	6289,308	6289,308	6289,308
Profits	-24776,179	-2175,345	-1301,970	1127,274	3642,997	3642,997	3756,205	3869,412

Costs per lot (4 ha)								
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8 to 12**
Estimate production (@/ha)			**160**	**480**	**800**	**800**	**800**	**800**
Costs	47428,459	8701,383	10239,329	10585,241	10585,241	10585,241	10132,410	9679,580
Cocoa average price (US$/@)	31,413	31,413	31,413	31,413	31,413	31,413	31,413	31,413
Incomes	0.00	0.00	5031,446	15094,339	25157,232	25157,232	25157,232	25157,232
Profits	-47428,459	-8701,383	-5207,882	4509,098	14571,991	14571,991	15024,821	15477,651

Costs per area (25 lots)								
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8 to 12**
Estimate production (@/ha)			**4000**	**12000**	**20000**	**20000**	**20000**	**20000**
Costs	1616346,960	217534,591	255983,228	264631,027	264631,027	264631,027	253310,272	241989,517
Cocoa average price (US$/@)	31,413	31,413	31,413	31,413	31,413	31,413	31,413	31,413
Incomes	0.00	0.00	125786,163	377358,490	628930,817	628930,817	628930,817	628930,817
Profits	-3,083,990.00	-415,056.00	-248,416.00	215,084.00	695,084.00	695,084.00	716,684.00	738,284.00

Table 11. Cocoa Production Costs in Three Different Situations

The information presented refers to the irrigated cocoa production in US$/ha, with a density of 1,111 plants/ha. According to experiments on irrigated cocoa, the expected production during the years for the presented data is:

Year 4 = 120@/há (1.8 tons)	Year 8 = 200@/há (3 tons)
Year 5 = 200@/há (3 tons)	Year 9 = 200@/há (3 tons)
Year 6 = 200@/há (3 tons)	Year 10 = 200@/há (3 tons)
Year 7 = 200@/há (3 tons)	Year 12 = 200@/há (3 tons)

where:
@ - Arroba = 15 kg
ha = 10,000 m^2.

Cocoa culture should be in a consortium with another culture in order to provide the necessary shading during the first three years of the cocoa culture. The choice of banana is due to its excellent productivity in irrigated areas, and also because it is a culture already consolidated in the area where the cocoa is spreading.

Next are presented banana production costs, the annual production estimate, and the average price of a kilo of banana.

Cost per hectare			
	Year 1	**Year 2**	**Year 3**
Production estimate (kg/ha)	250.00	350.00	400.00
Costs	4,005,031	3,166,457	3,166,457
Average price (kg)	0,146	0,146	0,146
Incomes	3,668,763	5,136,268	5,870,020
Profit	-336,268	1,969,811	2,703,563

Costs per lot (4 ha)			
	Year 1	**Year 2**	**Year 3**
Production estimate (kg/ha)	250.00	350.00	400.00
Costs (4 ha)	16020,125	12665,828	12665,828
Average price (kg)	0,146	0,146	0,146
Incomes (4 ha)	14675,052	20545,073	23480,083
Profit (4 ha)	-1345,073	7879,245	10814,255

Costs per area (25 lots)			
	Year 1	**Year 2**	**Year 3**
Production estimate (kg/ha)	250.00	350.00	400.00
Costs (100 ha)	400,503,144	316,645,702	316,645,70
Average price (kg)	0,146	0,146	0,146
Incomes (100 ha)	366,876,310	513,626,834	587,002,096
Profit (100 ha)	-33,626,834	196,981,132	270,356,394

Table 12. Banana Production Costs

The following study on cash flow provides important data for making a decision, since it is considered one of the main instruments for the analysis and evaluation of investment viability. Cash-flow projection allowed an evaluation of the Capital Return Period (TRC).

Cash Flow per há	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Cocoa Cash Flow after taxes	-24776,205	-2175,052	-1301,886	1126,834	3642,557	3642,557	3755,765	3868,972	3868,972	3868,972	3868,972	3868,972
Banana Cash Flow after taxes	-335,953	1969,601	2703,354									
Cash Flow per hectare	-25112,159	-205,450	1401,467	1126,834	3642,557	3642,557	3756,205	3869,412	3868,972	3868,972	3868,972	3868,972
Accumulated Cash Flow per hectare	-47,914	-48,306	-45,632	-43,481	-36,530	-29,579	-22,413	-15,030	-7,.647	-264	7,118	14,501
TRC - Capital Return Period **(year)**									**9.04**			

Cash Flow per Lot	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Cocoa Cash Flow after taxes	90,493	-16,602	-9,936	4508,909	14571,802	14571,802	15024,633	15477,463	15477,463	15477,463	15477,463	15477,463
Banana Cash Flow after taxes	-15024,633	7878,930	10813,941									
Cash Flow per lot	48773,060	-821,802	5605,870	4508,909	14571,802	14571,80	15024,633	15477,463	15477,463	15477,463	15477,463	15477,463
Accumulated Cash Flow	-48773,060	-49595,387	-43988,993	-39480,083	-24907,756	-10335,953	4688,155	20166,142	35643,605	51121,069	66599,056	82076,519
TRC - Capital Return Period **(year)**								**6.69**				

Cash Flow per Area 25 lots = 100 hectare	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Cocoa Cash Flow after taxes	-1616,346	-21779,874	-130197,064	112727,463	364299,790	364299,790	375620,545	386941,299	386941,299	386941,299	386941,299	386941,299
Banana Cash Flow after taxes	-33626,834	196981,132	270356,394									
Cash Flow	-1649973,794	20553,459	140159,329	112727,463	364299,790	364299,790	375620,545	386941,299	386941,299	386941,299	386941,299	386941,299
Accumulated Cash Flow	-1649973,794	-1670527,253	-1530367,924	-1417640,461	-1053340,670	-689040,880	-313420,335	140,278	460462,264	847403,563	1234344,863	1621286,163
TRC - Capital Return Period **(year)**									**6.81**			

Table 13**.** Cash Flow of the Three Situations Applied to the Project

A sensibility analysis was done involving production per hectare, average price of one 0,015 ton of cocoa, and the total area, in order to evaluate which factor influences the internal return rate (TIR) the most. One can note that the most influential factor is the size of the production area because in each change TIR varied 14% on average. Though product price is a very important factor, it was less significant compared with the producing area, once the average TIR variation is around 4%.

Internal Tax Return		Price (US$)						Area
		26.50	31.45	36.70	42.00	47.17	52.40	
Production for hectare	100 @ (1.5 tons)	.-----	-16.28%	-10.11%	-5.15%	-1.55%	1.51%	1 hectar
		.-----	-8%	0.00%	6.00%	11.00%	15.00%	1 lot
		.-----	-12%	-5%	1.00%	5.00%	9.00%	25 lots
	200 @ (3 tons)	-0.91%	3.81%	7.68%	11.02%	13.97%	16.64%	1 hectare
		10.00%	16.00%	21.00%	25.00%	29.00%	32.00%	1 lot
		5.00%	10.00%	15.00%	19.00%	22.00%	25.00%	25 lots
	300 @ (4.5 tons)	9.38%	13.93%	17.83%	19.75%	22.71%	25.42%	1 hectare
		23%	29%	31.00%	35.00%	39.00%	43.00%	1 lot
		17%	22%	25.00%	28.00%	32.00%	35.00%	25 lots
	350 @ (5.2 tons)	12.70%	17.22%	21.12%	23.13%	26.12%	28.86%	1 hectare
		27%	33%	35.00%	39.00%	43.00%	47.00%	1 lot
		20%	26%	28.00%	32.00%	36.00%	39.00%	25 lots
	400 @ (6 tons)	14.61%	18.97%	24.01%	26.10%	29.14%	31.92%	1 hectare
		28%	34%	39.00%	43.00%	47.00%	51.00%	1 lot
		22%	27%	32.00%	35.00%	39.00%	42.00%	25 lots

Table 14. Sensibility Analysis

5.5.1. Investments and Costs of the Processing Activity

Cocoa pre-processing and storage are activities that aim to prepare the product for commercialization and to preserve its quality characteristics until the final consumer (MI, 2006).

Cocoa pre-processing promotes the transforming of cocoa fruits into cocoa beans. In order to do so, the fruits should be opened on the harvest field, and the beans should be removed from the inside and transported, on the same day, to the fermenting boxes; afterward, the fermenting of the mass takes place, at the end of which the beans acquire a light brown color and lose the mucilaginous pulp surrounding them. Next, the beans are dried on trays lying in the sun.

To obtain efficient drying, it is recommended that the cocoa be dried on wood flooring trays. The trays are a fundamental structure in the cocoa processing. They are used for the drying of seeds, which are exposed to the sun during a week. They are built with wood, iron, and zinc. The zinc roof (Fig. 6) is built on tracks that allow the roof to be removed, leaving the tray floor, where the cocoa beans are, exposed to the sun.

In one year, a tray can load 220 kg of dried cocoa per m^2; that is, a 72 m^2 tray can load 15 tons/year for drying. Such a tray costs around US$ 17277,486.

Through the carried analysis it was possible to get Internal Return Rate (TIR) and Capital Return Period (TRC) for the three proposed models; that is: (1) production per hectare; (2) production on a 4-ha family lot, and (3) production in a 100-ha area. It is noticeable that 4-ha production was the most viable, once the TIR reached 16% and the TRC was 6.69 years.

Annual production: (per ha)	**250@/ha**
Annual production Lot (@) (4 ha):	**1.000@**
Annual production Area (100 ha):	**20.000@**

Financial indexes

TIR (Internal Return Rate**):**	**3.81%**
TIR (Lot = 4 ha):	**16%**
TIR (25 lots = 100 ha):	**10%**
TRC (Capital Return Period**) – Years:**	**9.04**
TRC (Lot = 4 ha) Years:	**6.69**
TRC (Lot = 4 ha) Years:	**6.81**

Table 16. Project Financial Indexes

6. Conclusion

Cocoa production in Brazil has suffered through an intense breakdown, especially in the Ilheus and Itabuna areas, due mainly to: (1) the occurrence of the "Witch Broom" disease, (2) the strong and enduring drought that occurred in the Ilhéus and Itabuna regions, (3) a price decrease, and (4) a lack of capital for cocoa producers at the moment they needed to invest in Witch Broom control and in the recovery of poorer areas. On the other hand, there is a significant increase in the food processing industry's demand for cocoa, resulting in a shortage of input for the chocolate industries.

Another fact pointed out by the cocoa bean processing companies is that the end of cocoa importation in Brazil is practically impossible, regardless of how much the production increases. This conclusion is due the fact that the cocoa-processing industries in Brazil have realized good efficiency associated with the production cost reduction in cocoa blending. Thus, today it is almost impossible to be competitive using only Brazilian cocoa, especially for industries that find in the importation of foreign fruits a way to reduce taxes.

Cocoa represents a very important culture for the country, especially in Bahia, the traditional cocoa region. This region are very affected, what makes the opportunity for the irrigated cocoa production, due the harmless witch broom,MMoves the production to a non-traditional area without cultural obstacles and with management facilities. Irrigated cocoa production also presents high productivity and bad conditions for the development of diseases, if the climate in the irrigated areas is extremely dry.

There is a possibility that the irrigated production could reach 6.0 tons/ha. On the other hand, there is an uncertainty regarding the real response of cocoa to irrigation, and some producers have experienced a decrease in productivity. The final answer will only be available with the betting of entrepreneur investors. Thus, it will be very important to watch closely the activities of actual cocoa producers on the bounderies of CODEVASF, and more specifically in the Formoso area, as an alternative for cocoa producing in irrigated areas to become more quickly viable.

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