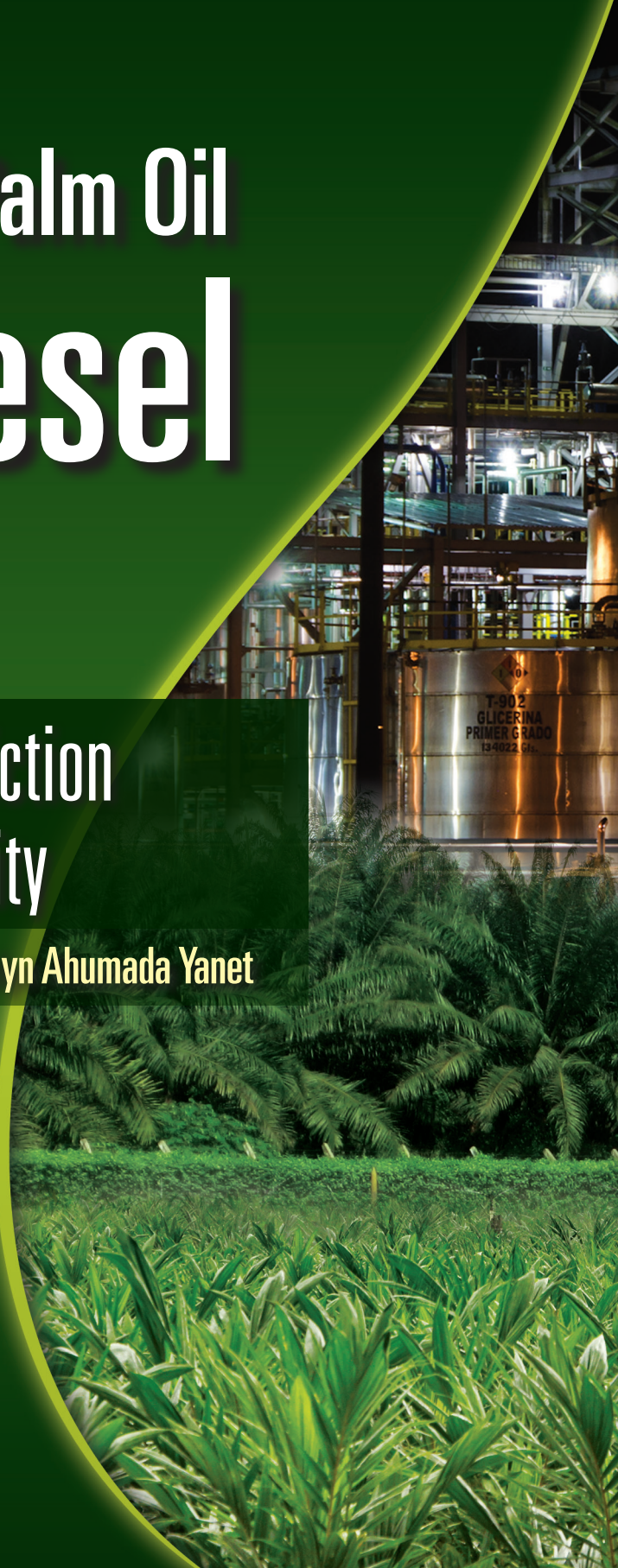
Colombian Palm Oil
Biodiesel

From Energetic Fiction to Business Reality

Alejandra Rueda Zárate · Marlyn Ahumada Yanet



Colombian Palm Oil Biodiesel

From Energetic Fiction to Business Reality

Alejandra Rueda Zárate · Marlyn Ahumada Yanet

Publication supported by Fedepalma with resources from the Oil Palm Development Fund

Authorized translation of the edition in Spanish of: *Biodiésel de palma colombiano, de la ficción energética a la realidad de un negocio*, published in Colombia by Fedepalma.

ISBN: 978-958-8616-59-9

Translated and published in English by Fedepalma

Translation
Adriana Arias de Hassan

International Editor
Joanne Robinson

Design and Layout
Fredy Johan Espitia B.

Printing
Javegraf

ISBN: 978-958-8616-62-9

Printed in Colombia
October 2015

Carrera 10A No. 69A-44
Bogota, Colombia
PBX: (57-1) 313 8600
Fax: (57-1) 211 3508
www.fedepalma.org

To God, to my parents and to all the people who with their hard work and commitment have made the biodiesel program a reality in Colombia.

To you, my Luna, for your love and devotion, for making my projects your own and allowing me to make your projects mine.

Acknowledgments

This book would not have been possible without the priceless help of a large number of people, all of them main characters in the great story of the development of the biodiesel industry in Colombia. They were always ready to share their information, experiences and impressions with us, giving new inspiration to the pen that gave life to these pages.

We would like to thank Abel Mercado Jaraba, Alberto Alarcón Guzmán, Amylkar Acosta Medina, Armando Daza Daza, Arturo Infante Villareal, Carlos Corredor Mejía, Carlos Gustavo Cano Sanz, Carlos Murgas Guerrero, César de Hart Vengoechea, Christie Johanna Daza Aragón, Daniel Cabuya Parra, David Cala Hederich, Eduardo del Hierro Santacruz, Elzbieta Bochno Hernández, Jaime Augusto Torres Novoa, Jairo Cendales Vargas, Jhon Agudelo Santamaría, Jorge Bendeck Olivella, Jorge Corredor Mejía, José María Obregón Esguerra, Julio César Vera Díaz, Luis Alfredo Orozco Lourido, Luis Ernesto Mejía Castro, Luis Fernando Herrera Obregón, Mauricio Acuña Aguirre, Miguel Krausz Holz, Rodrigo Belalcázar Hernández, Paolo Lugari and Tito Eduardo Salcedo Díaz, and Ecopetrol S.A.

Added to this list are the people whom we were unable to interview for different reasons, but who were instrumental in promoting the production and use of biodiesel in this country. Among them Andrés Felipe Arias Leiva, Camilo Marulanda López, Édgar Yáñez Angarita, Hernán Martínez Torres, Jesús García Núñez, Jorge Cárdenas Gutiérrez, Juan Miguel Jaramillo Londoño, Leonidas Tobón Torregoza and oil palm grower Luis Francisco Dangond.

We also thank the team at Fedepalma and Cenipalma, in particular Carlos Enrique Osorio Flórez, Strategic Sales Management Unit Director, Mónica Cuéllar Sánchez, Added Value Promotion Leader at Fedepalma, and Camila Escallón Escallón, Analyst for Fedepalma's Presidency. With their views and good judgment, they made the information enclosed here far more complete. We are grateful to Juan Carlos Espinosa, Environmental Leader; Andrés Castro Forero, Social Leader, and

Martha Helena Arango Villegas, head of the Oil Palm Information and Documentation Center (CID Palmero), for their help and patience during the writing of this book. Also, our thanks go to José Ignacio Sanz Scovino, Cenipalma's General Director, who provided key insights for this book.

We reserve a very special word of gratitude to Fedepalma's Executive President, Jens Mesa Dishington, for his enthusiasm and interest in enhancing our proposal, and above all, for the trust he gave us to record with pride and responsibility, in the annals of Colombia, the history of the palm oil biodiesel industry. This industry was called upon to create a landmark in the history of Colombia, in the same way that the Federation has done under his leadership.

Presentation

Results derived from the palm biodiesel project are proof of the fact that, together, Colombian oil palm growers can achieve great goals. This is one of the fundamental outcomes of the experience with biodiesel from oil palm: today, the country has a new world-class agroindustry with business leaders who trust the sector's drive and its ability to accomplish great things.

The entry of the oil palm growers into this business was a significant milestone in the history of our agroindustry, and Fedepalma gave its critical support, having learnt from experience that unity gives strength. We understood that the sector was ready to look for greater added value and helped outline the basic rules that govern this business. In so doing, a decisive contribution to the country's development.

Álvaro Uribe Vélez became President of Colombia in 2002 and from the very start of his Administration he was determined to promote biofuels. He made this task one of the strategic pillars of his agricultural policy and created new possibilities for the sector's development, which we as oil palm growers had not yet envisioned for the short or medium term.

At Fedepalma we were aware of the possibility of using palm oil as fuel for producing biodiesel for motorized vehicles. We knew it was one of the multiple uses for palm oil and that it was technically feasible. But recognizing a business opportunity was another thing. Early in the 2000's biofuels were merely an exotic option for palm oil and the creation of the right conditions for making it a reality was not within our immediate scope.

However, a study commissioned by Fedepalma in 2003 on the *Technical and economic pre-feasibility of producing crude palm oil by-products as fuels for diesel engines in Colombia,* carried out by Arturo Infante Villareal and Eduardo del Hierro Santacruz, showed that we should definitely support the National Government with its biofuel initiative, in particular the biodiesel initiative, because of the great

scope for biodiesel which could result in significant short-term developments for the sector and, therefore, had to become an important undertaking for our industry.

During the Oil Palm Congress in Santa Marta in June 2004, President Uribe Vélez explained that he saw great potential in the sector as a source of rural employment and reduced fossil energy dependence for Colombia, and announced his intention of working on the immediate viability of the biofuel project.

Many of us thought that biodiesel production was a complex issue that only the major league businesses could tackle; multinational corporations such as Exxon Mobil, Texaco or BP. However, another study commissioned later with the investment banking firm Q&A to assess the financial feasibility of setting up a large scale palm oil biodiesel plant, showed, early on, that the investment required was only a fraction of what the oil palm growers had already invested in their crops, and the mill required to supply it. At that point we recognized, for the first time, that if we were to add significant added value to the domestic oil palm agroindustry, we had to join forces around the biodiesel production projects because those who entered from the beginning would help set the rules for the new business and determine how benefits would be distributed.

We discovered that if oil palm growers came together, the investment would be reasonable and would allow many producers to enter the business. Although our initial enthusiasm was not enough to shape a large national project born within our sector, starting in 2006 five important biodiesel production initiatives came to life, two of an individual nature and three as a result of the Federation of regional producers. Since then, three other smaller plants have come into production.

A very important lesson for Fedepalma has been on attitude, politics and achievements relating to the other links in the sector's production chain. We have learnt to act as a driving force for agricultural production activities with downstream, forward vertical integration, without losing our identity and character as an oil palm grower's organization. Indeed, the Federation has long cherished the principle of keeping for itself the initial stages of growing the oil palm and processing the fruit, which perhaps explains why we have remained strong.

But things have not stopped there: many years ago a large number of producers became interested in taking the next step of integration, first with the food industry and, more recently, with the biodiesel industry. Consequently, the Federation has always been open minded and has strived for balanced and harmonious co-existence with the other activities in the productive chain, trying to get to

know and understand them, and so creating openings for our affiliates in different businesses. We have not been passive witnesses of the traditional business but rather have been proactive in order to be prepared for what may come in the future – with projects for new uses of co- and by-products at the mills, and countless other downstream opportunities.

This integration has had significant impact on optimizing income for the various representatives in the production chain. Why is this worth highlighting? Because in other agricultural areas in Colombia, income is distributed unequally, given that the rules of the game in those businesses have been established by those closest to the consumers who have kept the largest part of the marketplace margins for themselves. This lack of integration with the first links in the chain is not the case in palm oil, where distribution has reached the oil palm growers, creating conditions that enhance the relative attractiveness of this agricultural sector, allowing it to maintain its growth, with the involvement of small, medium, and large producers.

This is a very important reflection of the politics in our sector since, contrary to what many people think, the integration of the productive areas not only takes into account the interests of the primary links, but is also a way to protect the sector's fundamental interests. In contrast, absence of integration and a rupture in the relationship with the other links in the production chain would result in a permanent war among the participants and hinder the ability to negotiate and derive reasonable results for all. In this way, we not only see an accomplishment for the industry in the present but an example for the future development of policies for our own sector and for others.

At Fedepalma we advocate the need to come together in order to accomplish great things. This, as well as the way our members are organized, our institutions, directors and our specialized teamwork, goes a long way to explain many of our achievements, including biodiesel. In particular, I wish to mention Cenipalma, the Oil Palm Research Center, with its technical work in partnership with several academic institutions, which has been instrumental in making palm biodiesel a reality in Colombia.

The book *Colombian Palm Oil Biodiesel: From Energetic Fiction to Business Reality,* co-authored by Alejandra Rueda Zárate and Marlyn Ahumada Yanet, with the support of a valuable team of people, opens a window into the way this process was developed. It is important to record the details of this story so that present and

future generations can learn from the experience and realize that, in agriculture, it is not only possible to dream but also to develop great sustainable business opportunities at all levels.

Many thanks,

JENS MESA DISHINGTON
Executive President of Fedepalma

Table of contents

Chapter 4

Chapter 5

Chapter 6

Epilogue

Oil palm *Elaeis guineensis* genus. Photography: Toro, F. (2009)

Foreword

The publication of *Colombian Palm Oil Biodiesel: From Energetic Fiction to Business Reality* is an important academic contribution from Alejandra Rueda Zárate and Marlyn Ahumada Yanet that confirms why Colombia is one of the countries with the greatest potential to become regional and global source of alternative energy, especially agro-energy or biofuels.

Economists agree that the greatest hurdle to sustained world economic growth in the future will be the need of clean fuels, hence the significance of biodiesel. This led our Administration to commit its efforts to making Colombia a leader in the use of biofuels, and thus counteracting the decline in oil production through a comprehensive policy of alternative energy sources.

Under the framework of Democratic Security, we enthusiastically introduced the necessary tax incentives, technical regulations and price guarantees. We considered that this held great promise for reactivating rural employment and production, and reaching international markets. At the same time, we foresaw a contribution to the fight against global warming through environmental sustainability, a contribution to agro-industrial development, and also to improved quality of the fuels produced in our country.

As part of our Administration's commitment to the production and sale of biofuels, we created incentives for oil palm growers, incentives for free zones for biofuel agro-industrial projects, support for production through the secure agricultural income program (*Agro Ingreso Seguro*) and the rural capitalization incentive program. Likewise, we eliminated the biofuel sales tax, and from 2008 implemented biodiesel/diesel blends.

All these developments are conscientiously reported by the authors in six chapters that review the story of biodiesel in our country, allowing this book to be an excellent tool for the expertise in environmentally-friendly fuels, particularly those who see palm biodiesel with global vision, and not just as a national project.

Colombian Palm Oil Biodiesel: From Energetic Fiction to Business Reality is a scientific and educational piece of work that will give the world a reasonably optimistic view of Colombia's potential as a producer of alternative fuels derived from raw agricultural materials. It is also a lesson in the kind of development that can be achieved when the productive sector – under the leadership of Fedepalma in this case – the academia and the Government work together.

ÁLVARO URIBE VÉLEZ
President of the Republic of Colombia
2002-2010

Introduction

Presence of iguana in oil palm plantations realizes palm biodiversity. Photography: Lemus, E. (2012).

Synergies: a winning approach

Strengths lie in
our differences, not
in our similarities.
Stephen Covey

Success is not achieved
only with special qualities.
It is above all a matter
of persistence, method
and organization.
J.P. Sergent

The development of the biodiesel market in Colombia is characterized by its design, implementation and results. Its features may be of great value for those people who are interested in optimized management practices and, more specifically, for those who are directly involved in the study, justification and promotion of alternative sources of energy.

The biodiesel world in our country encompasses elements of social, economic and environmental policy conveyed through government speeches and carefully crafted technical documents from academics and environmentalists and, of course, through the expectations of various stakeholders who participate in several areas including the rural and urban sectors. But leaving aside the thinking and vested interests of the various stakeholders and those responsible for a program designed primarily to benefit the Colombian population, it is important to recognize and make the most of the synergies that, even in the midst of the differences, could be achieved in order to gain approval and general support for this undoubtedly successful program.

Biodiesel is now an integral part of Colombian life. It is a powerful energy resource in the alternative energy portfolio, with low environmental impact and high social potential, and most importantly, it is a short-term renewable, reasonably priced energy source for the business people involved in its production.

It will come as no surprise to the reader to sense the smell of bioenergy flowing from the pages of this book. The book includes true stories designed to bring to life the different working themes of the past years so as to provide the public with the possibility of coming closer to the experiences lived by the participants of the oil palm sector as this new biodiesel market emerged.

The results of this project show the advantages of teamwork and of reaching agreements of mutual benefit for all the parties involved. This exercise at compromise and collaboration will no doubt set the example for building modern communities, where participation and respect for differences are critical for the formation of values in any society.

This book is a record of experiences designed not only to shed light on a specific problem or to answer the readers' questions, but also to serve as a source of knowledge. In particular it uses case studies to offer new managerial learning techniques. The development of the National Biodiesel Program was a holistic process, understood as the sum of actions undertaken within a specific time frame, under a clearly established context, where there was always a logical, consistent link between all the activities of the different participants. Stories are analyzed with the aim of showing and highlighting the work of cooperation and coordination carried out by the various sectors, regardless of their nature and of their individual interests.

The interviews and discussions with the different participants during the definition, implementation and execution phases of the National Biodiesel Program, together with the experiences of Alejandra Rueda Zárate,[1] co-author of this book, are valuable sources of information that will make this book a useful tool for extrapolating these experiences to other sectors and other countries interested in structuring and developing a new market.

1 Fedepalma Marketing and Market Promotion Program Director who participated in the development of the National Biodiesel Program between 2005 and 2008 and then went on to complement her experience with a masters degree in Energy and Resources at the University of California-Berkeley. On returning to the country she again joined the oil palm sector as advisor to the President of Fedepalma from 2010 to 2011. World Peace Fellow 2008-2010.

The outcome of successful cooperation

The dawn of the 21st century finds the international community faced with a highly disrupted environment characterized by the potential reduction of world hydrocarbon reserves – the main source of energy consumed at an increasing rate – the notorious and harmful effect of CO_2 emissions from fossil fuels, and the high levels of agricultural stocks and government subsidies to producers in the developed world which widen the poverty gap between developed and developing countries.

The situation in Colombia is no different. In 2004, oil reserves were estimated to last for only seven more years and, to make matters worse, there was the shame of producing a diesel ranked amongst the top pollutants in the whole planet. Additionally, Colombia was also generating agricultural surpluses, although it was not very competitive in the highly subsidized international market.

But perhaps what is most critical about the Colombian case is the unfortunate existence of a climate of violence in large agricultural areas of the country. This is still creating detrimental effects in the rural areas, despite slight improvements in recent years. However, at the same time, there is a strong desire among the people to attain attain a solid and stable economic reactivation as an opening to new opportunities.

Consequently, the need to improve energy self-sufficiency, and the pressing necessity to reactivate the rural economy by creating new possibilities that would enable the people to find stable jobs and earn a living with dignity, were two challenges that weighed heavily on the National Government. On the other hand, academics and experts in the energy field, who were pushing for alternative fuels, imposed great pressures on the state-owned oil company with its marketing of locally-produced diesel containing 4,500 parts per million of sulfur.

In the meantime, the oil palm sector which had experienced dizzying growth at the time of the economic openness and during the first few years of the new century was facing a situation where palm oil production greatly exceeded the domestic demand and where the conditions of the international oil market preempted any possibility of competitiveness.

This meant that there were an important number of stakeholders who were trying to find solutions to their problems and further their interests. They were encouraged by the implementation of government development policies and the will and trust of private sector investors, which led them to end up gravitating to a product that became a common variable for all: palm oil.

Oil palm crown. Photography: Toro, F. (2009).

Decisions were then made that would set the stage for the coordinated work and effort of a multi-disciplinary team of private and public sector professionals guided by the contributions of academic research. This eventually resulted in the groundwork for the National Biodiesel Program with its main objectives of strengthening energy self-sufficiency, creating jobs in the rural areas and reducing atmospheric pollution through the creation of a new market: the biodiesel market.

President Álvaro Uribe Vélez not only decided to back the undertaking but also showed the way to the future of the country in terms of energy, integrating it into the world development for clean energy sources. Consequently, Fedepalma, led by Executive President Jens Mesa Dishington, played a pivotal rol in this project, which with its Fedepalma's technical support and long-term vision, managed to see potential markets with great possibilities for oil palm and its products: those of oleochemicals and renewable energies.

Diesel-biodiesel blends were implemented in 2008, three years after having included biodiesel in the National Roundtable of Biofuels, a forum for debate and agreement on public policy. It was after 2004, however, that the technical and legal groundwork was implemented to allow domestic production. Since the introduction of blends, Colombia has been consolidating the use of this biofuel, to the point where, in 2012, B10 blends (10% biodiesel and 90% diesel) were being used in almost all the country.

The sum of many stories

Renewable fuels, and biodiesel in particular, began to come on the scene in the second half of the 1980s; however it was only two decades later that they came to Colombia to stay.

One could say that nature, world economic conditions, the impetus of the oil palm growers and associated industrialists, together with the commitment of the national institutions, conspired to enable Colombia to emerge into the 21st century as an outstanding example among the countries that had the potential to research and generate alternative energy sources. It undertook the task of guaranteeing the normal development of biodiesel production activities, whilst taking all the necessary steps to avoid causing a negative impact on the environment.

Consequently, the front page of a document designed to give a detailed account of the meaning of biodiesel for society as a whole, and for the economy in particular, must highlight the institutions that promoted and guided a large diverse group of participants towards the well-deserved place that this fuel holds today. At the same time, it is important to stress how right it was to select oil palm as the raw material used, following the trajectory of producers from other countries with different options, none of them having all the advantages that oil palm offers to Colombia.

Delving into the details of the last stretch in this success story, it is worth noting that the greatest significant push from the government came in 2002 with the decision that all government plans and actions required the support, primarily, of the democratic security program. The aim of this program was to recover territories that were under the control of illegal armed groups, restoring the trust of the investors, and reenergizing agricultural activity[2]. During the past six decades,

2 Fundamental pillars of President Álvaro Uribe Vélez's Administration.

Colombia has been in the grip of social conflict resulting mainly from drug trafficking, which is the primary source of income for criminal armed groups,[3] who use the rural areas as headquarters for their illegal activities. Besides ousting and stripping innocent peasants of their lands, they impose their control over the territories, restricting private investment in agricultural or rural activities.

The government was also facing sustained reduction of proven reserves of crude oil as a result of the declining production of the oil fields and absence of the discovery of any new sources, explained in part by the difficulty of exploration in areas with inadequate law enforcement. This was happening as the country went through a process of *dieselization* and was under pressure to increase the use of this polluting fuel.

Under such circumstances, it was evident that the domestic supply of energy was in grave danger and the government, convinced of the need to strengthen the armed forces and law enforcement institutions, decided to take steps to foster foreign investment in oil exploration and production. At the same time, it looked for ways to lessen the contamination created by the transportation sector, which was the main consumer of fossil fuel.

The academic world, worried by the imminence of a potential oil crisis and the painful consequences of using poor-quality fossil fuels, focused its research on alternative fuels. This research was frequently supported by outstanding experts in the energy sector.[4] The exploratory work was shared and endorsed by international peers and reinforced by experiences from other countries that had already been making progress in the development of renewable liquid fuels or biomass-based fuels for more than a decade. It was then that oil palm caught public attention. With much greater yields per hectare than other oil-bearing plants and with a much lower content of nitrous oxides compared to other biodiesels, it was seen as the best raw material for biodiesel production.

At the same time, despite price increases in recent years, the agricultural sector had not been able to recover from a long period of low prices resulting from large amounts of stocks. The international prices of many basic commodities reached a historical drop between the late 1990s and 2001. So, in general terms, this sector in Colombia was a defenseless victim not only of economic aperture but also of

3 Guerrillas, paramilitaries and criminal gangs, among others.

4 People like David Cala, Eduardo del Hierro, Jorge Bendeck and Amylkar Acosta, to mention only a few.

decreasing revenues resulting from its position as an international price taker. In the case of oil palm, prices fell below 300 dollars per ton when production costs were much higher.

In addition, there were large existing and predicted surpluses of palm oil. This oil accounts for more than 90% of oils and fats production in Colombia. Domestic demand had stagnated, and by 2007 exports were 40% of the total production. Despite all this, the government recognized this crop as a source of social stability in the rural areas and decided to promote and drive its expansion with the belief that, by making it into biodiesel, it could also provide a potential solution for self-sufficiency in energy production as well as for the reduction of fossil fuel emissions.

Palm oil producers, under the leadership of Fedepalma, decided to cautiously take up the challenge posed by the country's situation, and an unrelenting President Uribe. The business leaders did their homework, including technical and marketing research, prefeasibility and feasibility studies, which resulted in concrete investments in six biodiesel plants, five of them vertically integrated with the oil palm plantations.

Thus, new participants joined the major leagues of the national economy, becoming a key link in the fuel supply chain for transportation under the name of *biodieseleros* (biodiesel producers). They are domestic oil palm producers for whom farming is their heart and soul, and who know that by positioning their product as one of many substitutes for fossil fuels they are also creating a new momentum for agriculture in our country.

The cultivation of oil palm generates social stability in the countryside.
Photography: López, A. (2011).

A winning vision

In Colombia, as in the rest of the world, the agricultural sector has always been seen as the ugly duckling, the weak duckling and the poor duckling of the economic development story, despite its close interconnection with the rest of the economy and its importance as a food supplier.

Consequently, the idea that palm oil producers would want to enter a state-of-the-art economic sector; the energy sector, with huge investment requirements, seemed rather far-fetched. The other players in the field were no more and no less than large companies, world economy tycoons who would not be willing to surrender a slice of their business. Indeed, one of the biggest fears was what the palm oil producers saw as a huge entry barrier: the financial clout required for this new undertaking. However, that fear was overcome when the prefeasibility and feasibility studies showed that the money already invested in the plantations was between six and ten times higher than the investment required for the industrial plant. Added to this was the boost from the Government, who were intent on overcoming every single stumbling block set up by the wholesale diesel distribution sector, which was reluctant at first to go along with the implementation of biodiesel-diesel blends.

However, just as biodiesel, for the oil palm growers, has been the gateway to this new and promising world of oleochemicals as well as a potential substitute for petrochemical products, so too have oil producers seen their direct involvement with biofuels as a good market opportunity. Such is the case of Ecopetrol S.A. which has become a shareholder in Ecodiesel, and Petrobras has done something similar in Brazil.

Shyly, with an attitude of collaboration that was, or appeared, rehearsed at first but which would gradually build into trust, they taught each other their businesses. The interests of the oil palm agribusiness, of the oil companies and of the transportation sector began to converge, creating technical cooperation that eventually resulted in road tests carried out jointly by Fedepalma, Cenipalma, Instituto Colombiano del Petróleo and Ecopetrol S.A. with Sí 99 and General Motors. The test results were excellent for the various blend levels that could be implemented in Colombia; the final test was closely supervised by the Universidad de Antioquia in order to give greater legitimacy and credibility to the project.

The technical discussions between the various sectors led to the establishment of quality control standards for biodiesel and the identification of best handling

practices throughout the supply chain. Also, a win-win agreement was reached between the wholesalers and Ecopetrol S.A., whereby the biodiesel blend was defined as 2% at the refinery and 3% at the wholesale distribution facilities. The additional percentage is left to the wholesaler, except when otherwise stated in the regulations.

Furthermore, the Government's dream of driving the growth of the agricultural sector using a crop that could build the social fabric became a reality in regions previously marginalized under the scourge of violence. Cases in point are that of Maria La Baja and Catatumbo, where a large part of the production coming from farmers who own an average of 10 hectares of land each now goes to biodiesel production.

Hurdles

The main challenge for this initiative was that, although soybean and rapeseed biodiesel was well known in the world, the same was not true of palm biodiesel. Motorized vehicle manufacturers, academics, wholesalers and the international transportation sector extrapolated results obtained with the known biofuels to palm biodiesel, disregarding the physical and chemical differences between them. Moreover, the little knowledge available about the performance of palm biodiesel had been acquired under very different conditions from those produced by the climate and altitude of Bogota (8,530 FASL).

Using rigorous technical test results, each of the hurdles or myths raised by the different multi-national corporations about biodiesel use were gradually refuted. Also broken was the paradigm related to the pipeline transport of biodiesel/diesel blends, even in cold climates.

Another difficulty for the oil palm growers, related to the market characteristics, was the ability to achieve a reliable supply. The Ministry of Mines and Energy requires minimum stock levels in order to reduce the supply risk at times of low palm oil production, allowing for the fact that the raw material for biodiesel production is very vulnerable to various external factors such as climatic conditions. This doubtless has an effect on the cash flows of biodiesel producers who have to pay for the raw material up front but many times have to store the product in holding tanks for a specific time period.

Aside from these challenges related to production, there were others that both biodiesel producers as well as oil palm growers had to deal with: the extrapolation of outcries about deforestation in Malaysia and Indonesia, concerns about

land-use change and forestry (LUCF), CO_2 emissions, and the great social and food safety concerns put forward by different non-government organizations (NGOs) around the planet.

In order to make a distinction for the national and international communities between the practices in each country, the Ministry of Mines and Energy, with the support of the Inter-American Development Bank (IADB), commissioned EMPA, an international expert in environmental impact, to conduct the study on "Life cycle assessment of the chain of production of biofuels in Colombia". The results of the study showed that greenhouse gas emissions were reduced more than 83% compared to fossil fuels, using palm oil biodiesel produced in Colombia, and they could even amount to 108% with additional investments in, for example, methane capture from wastewater treatment systems. These results were dramatically different from those of the main oil palm producing countries.

In terms of food safety, Colombia has surplus production of palm oil, which means that volumes used in the traditional food industry would not be affected. On the contrary, biodiesel would be another contribution to international markets that would not be affected by the absence of Colombian supply, which is actually less than 0.5% of the total volume sold abroad. Also, there would not be any pressure to increase prices as Colombia is an international price taker (not setter).

Considerations

Undoubtedly, oil palm has been one of the fastest growing areas in the agricultural sector, due to various factors, including sound institutions that characterize it, as is the case of Fedepalma, which has represented it for fifty years. There is also a strong commitment to environmental and social sustainability that allows for smooth interactions with the government and the development of trust. This contributes to the building of a better country.

Furthermore, partnerships between large and smallholders are the groundwork for the development of a new class of rural entrepreneurs. Together with biodiesel development, this exemplifies the kind of joint public-private action that translates into social, environmental and economic benefits for society as a whole.

There were many sectors and individuals who participated in the development and implementation of the National Biodiesel Program, all of them with different perceptions about oil palm, including people with divergent feelings towards the crop and its growers, even though they had no knowledge about either of them.

These feelings, or biases rather, were dispelled gradually through the joint work of visiting the plantations together, debates and discussions, weekly at first during the definition stage, and then monthly during the implementation phase, until they were spaced out during consolidation. All this resulted in knowledge of the oil palm tradition in Colombia and of the conscientious work of the growers and their respect for the country and its people.

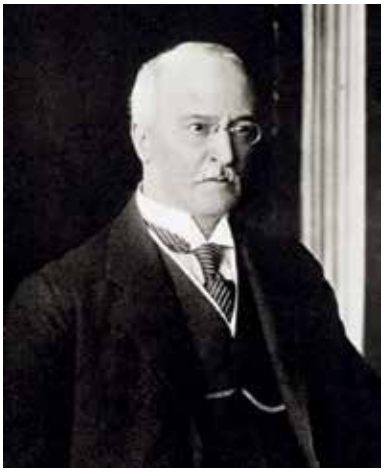
The oil palm crop and its main product, palm oil, play the leading roles in this story of a sector that could not remain on the sidelines watching as this country was built and rebuilt, but on the contrary, is committed to lead and drive its progress.

Chapter 1

Biodiesel testing station in Bogota.
Photography: Gutiérrez, R. and Holguín, J. L.(2008).

The world of biodiesel

The Stone Age didn't end
for lack of stone, and the oil
age will end long before
the world runs out of oil.
Quote attributed to an Arab sheik



Photography: Rudolf Diesel.

The 20th Century witnessed the fastest technological breakthroughs ever to be seen in the history of mankind. Many of them happened in the field of transportation. In the late 1800s the German Rudolf Diesel invented and patented the engine named after him, but it was only in 1900 that he launched it publicly during the World Exhibition in Paris. This engine was the first built for palm or coconut oil-based biofuels, although he used peanut-oil for its demonstration. Some years later, in 1912, he stated:

> The use of vegetable oils for engine fuels may seem insignificant today but such oils may become, in the course of time, as important as petroleum and the coal-tar products of the present time.

There could not have been a better prophet. Today, exactly 100 years after he made his prediction, vegetable oils, and even animal fat, are the raw materials for biodiesel and are being blended in increasing proportions with diesel. Unlike the oil boom at the time when Diesel developed his invention – that actually pushed vegetable oils out of the limelight and opened a wide door for the development of fossil diesel – today the "black gold" sells for a high price, is

in short supply, and there is growing awareness of its harmful effects on the environment.[1]

The oil industry was born in 1859 when Colonel Edwin L. Drake discovered oil and drilled the first well in Pennsylvania (USA). In 1886, German engineer Karl Benz designed and patented the first automobile that used the recently invented Otto[2] (or gasoline) engines. It was the dawn of a new means of transportation and, consequently, of the commercial use of fossil fuel and derivatives.

In the mid-1950s, geophysicist M. King Hubbert devised a mathematical model to predict oil extraction levels over time. In 1971, using estimates for world reserves of crude oil, he predicted that production would peak between 1995 and 2000 and would then decline over the following years. Consequently, Hubbert's curve set the end of the fossil fuel era at a time when the energy cost of extracting a barrel of oil would be equal to the cost of the same barrel of oil, which would start happening once peak extraction was reached.

Later, based on more recent information on production technology and crude reserves, geologist Colin Campbell estimated that the global peak rate of extraction would happen in 2010. As he stated in his famous article "The End of Cheap Oil",[3] the critical period would not come with depletion but with declining production.

Despite criticisms of these models based on the accuracy or inaccuracy of the variables, it is clear that there will be future limitations in fossil fuel supplies, although the exact date of its heralded end is not clear. In any case, scientific forecasts, in addition to the 1979 energy crisis, the Gulf War – that sent prices of crude oil soaring in 1990 – and then the 9-11 attack, set off the alarms in industrialized countries, which are highly dependent on imports of fossil fuels, and highlighted their urgent need for developing local alternative sources of energy.

Besides these supply and demand issues, the decade of 2000 was characterized by the steady increase in international oil prices, from 30 dollars per barrel in the first years to a high of 145 dollars in 2008, and then a leveling off at around 100 dollars per barrel, where prices have remained since then.

1 Natural gas, coal, and oil.

2 In 1886,German engineer Nicolaus August Otto invented the internal combustion engine (gasoline), also known as the "otto cycle" or "spark-ignition engine". It is based on the principle of explosion by internal combustion, unlike the diesel engine that works by compression.

3 Article published in *Scientific American* in 1998 together with Jean Laherrere.

At the same time, the world woke up to "climate change".[4] The temperature in the planet is rising due to higher greenhouse gas (GHG)[5] emissions originating from industrial activity and transportation. GHGs have the property of retaining or trapping sun radiation reflected from the earth in such a way that surface temperature on the planet increases, hence the name "greenhouse effect".

Temperature rise on Earth was first discovered in the 1970s, but what is more serious is that it will continue at such a shocking rate that, during this century, the planet's temperature will increase by 2 to 4.5 °C,[6] the greatest global warming to occur in the past 10,000 years. This will doubtless have an impact on the development and adaptability of the human race as well as the ecosystem. Consequently, there is a need to act quickly, starting with changes in consumption habits.

One of the biggest challenges for mankind, therefore, is to stop climate change. The international community has already adopted a series of mechanisms to alleviate its effect. These include the Kyoto Protocol, an international agreement that seeks to reduce GHG emissions, in particular through innovations in a sector that has grown steadily and contributes 40% of total world emissions: transportation.

Indeed, more than 1 billion vehicles are driven on the world's roads, and it is estimated that this figure will reach 1.8 billion by 2025. In the United States alone, there are 300 million vehicles, and transportation in the member countries of the European Union contributes to 19% of the total emissions, without taking into account ships and aircraft.

In this context, biofuels such as biodiesel are an important alternative. Biodiesel is readily degradable; it is not dangerous because its flash point is above 110 ºC; it does not contain sulfur and, consequently, does not emit sulfur oxide; in a blend with diesel, it improves the lubricity of the fossil fuel; being less volatile, handling and transportation are safer; because of its lubricant properties, it is a good additive that reduces wear and tear in the engines; and this, together with its detergent power, helps maintain injection systems clean.

Moreover, it reduces soot emissions as well as CO_2 production during combustion. Unlike hydrocarbons, it contains no benzene or other carcinogenic or pollutant substances that promote the development of respiratory diseases.

4 Climate change consists of climate variations as a direct or indirect result of human activity.

5 Mainly gases such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs).

6 According to the UN Inter–government Panel on Climate Change, IPCC.

Consequently, developed countries began to talk about energy crops or biomass[7] as sources of liquid biofuels, and this included discussion about a new stage in agricultural activity that, without doubt, should promote rural development and boost agriculture, just like Rudolf Diesel had envisioned in his time.

Europe: a pioneer in the biodiesel industry

Biofuels began to receive significant support from governments in the industrialized countries. From the European perspective, and prior to a series of pilot tests for biodiesel production using rapeseed as the raw material, the 1990s brought a number of policies focusing on the use of clean energy and the reduction of dependence on fossil fuel imports.

The ratification of the Kyoto Protocol by Europe, together with the steady growth of the transportation sector, accounting for over 30% of final energy consumption, plus the environmental impact of its emissions, played a critical role in the implementation of European environmental policies. The member countries of the European Union committed to an 8% reduction of their CO_2 emissions by 2012, compared to their 1990 levels. Biodiesel became their ally in honoring this commitment, which also included that in relation to fossil fuels, renewables must reduce GHG emissions in 35% by 2013 and 50% by 2017.

Another important role in the development of biodiesel production was played by the surplus production of vegetable oils, most of which was absorbed by this new market and controlled by the "Land Set Aside" policy[8].

Then a series of public policy provisions arose, one after another. In 1997, the white paper on *Energy for the future – renewable sources of energy,* postulated the use of 18 million tons of liquid biofuels by 2010; later, the *Green Paper: towards*

7 Biofuels in liquid or gas form for use in transportation are obtained from biomass, i.e., the biodegradable mass or fraction of waste and residues from agriculture, forestry and associated industries, or from industrial waste. Biomass is sun energy converted into organic matter by the plants. Plants transform the energy of the sun into chemical energy through photosynthesis, and part of that energy is stored in the form of organic matter and is recoverable through direct combustion or through transformation into fuel.

8 The Community Agrarian Policy (CAP) which determines, amongst other things, changes in soil use in member countries of the European Union, promoted the measure of removing land destined for crop production, based on mandatory abandonment of crops, in order to reduce surplus agricultural production and lower stock volumes.

a European strategy for the security of energy supply[9] highlighted the fragility of the regional energy system, and created an even wider opening for biofuels, which were required to contribute 20% of the total use of fuels by 2020.

This determination was further captured by the European Commission Directive of 2003[10], designed primarily to consolidate the biofuels market in Europe. The Directive set a global goal of 5.75% use of biofuels by 2010, and set into motion a whole series of tax incentives to pave the way.

In 2009, the European Directive on renewable energies issued a decree to all their members instructing them that, by 2020, 10% of the energy consumed by their transportation sectors should come from renewable sources. It covered specific sustainability requirements on the one hand, including emission reductions of at least 35%, resulting from the use of biofuels, and on the other hand, it also referred to economic and social developments designed to reduce the impact on food prices and maintain the conventions of the International Labor Organization (ILO).

The same regulation also considered three main aspects surrounding renewable fuels: a) to minimize greenhouse gases resulting from transportation; b) to create additional development opportunities for agriculture in Europe; and c) to reduce energy dependence. These policies resulted in an increase in biodiesel production from 64,000 to 9.7 million tons between 1992 and 2011.

Moreover, in order to encourage biofuel production and use, the European Commission defined incentives for energy crops of up to 45 Euros per hectare for a specific number of hectares, estimated at 2 million in 2006. Some European countries did not only grant tax exemptions based on progressive reductions in fossil fuel production, giving rise to a significant commercial advantage for biofuel production but also provided support for research. Just like subsidies or incentives, production cost reductions were critical for biofuel sustainability, because the energy crops, when used as raw material, are the most significant cost component, at 60 to 90% of the total.

The early technical tests with biodiesel were conducted in 1982 in Germany and Austria, and three years later, the first European pilot production plant was built in Austria. Although progress was slow until 1998, the increase in international

9 The *Green Paper* was developed by the European Commission and adopted by the Commission itself in November 2000.

10 Known also as the Biofuels Directive.

oil prices in 1999/2000 enhanced the profitability of biofuels, making production sustainable. This resulted in expansion of the installed capacity of the production plants, in particular in Germany, where production increased from 100,000 tons in 1997 to close to 1 million tons in 2003. Consequently, Germany became the leading biodiesel producer, and developed the quality standard (DIN 51606) that served as a guide for the establishment of performance requirements and defined the technology. This standard was the basis for the European standard regulation for biodiesel (DIN EN 14214).

Germany also showed the way for biodiesel marketing: there it was sold pure (B100) in service stations, because it was the only country to have exemptions on fuel taxes. The percentage of biodiesel contained in the solution is designated with the letter "B", followed by a number: pure biodiesel is called B100 and a fuel containing 10% biodiesel is labeled B10.

However, in 2003, contrary to what happened in France and Italy, the fiscal benefit was extended to blends, and biodiesel began to be sold blended in varying percentages with fossil diesel.

Besides tax considerations during this period, they also used advertising campaigns to promote the use of biodiesel, focusing on the following attributes: a) it is produced from rapeseed and is an economic alternative for the development of the German agricultural market; b) pure biodiesel is environmentally friendly; and c) biodiesel is a technically developed, top–quality fuel, subject to important quality controls from the source all the way through to the distributor. The result: more than 1,400 German service stations were selling biodiesel.

The European Biodiesel Board (EBB), which gathers the main producers together, played a pivotal role in promoting the fledgling industry. Created in the second half of the 1990s, it was designed to support scientific, technological and legal activities, and also to suggest economic, institutional and technological public policies for the EU.

In recent decades, aside from Germany and Austria, France, Spain and Italy have also been pioneers in the use of biodiesel, as well as in the technologies to produce it from rapeseed and sunflower. Even European auto manufacturers, including Volkswagen, Seat, Audi and Skoda, consented to the use of biodiesel in their engines, which is now specified for particular models.

The European Union accounts for 50% of the global biodiesel production. Production capacity reached 22 million tons in 2011, but only 9.7 million were actually

produced, although consumption for that year amounted to nearly 13 million tons. This occurred because the remaining 4 million tons were imported, highlighting the unused capacity as a result of the lower cost of importing the agri–fuel coupled at that time with the world economic crisis and its effect on demand. As a result of that situation, many biodiesel plants went out of business even before starting operations, or had to operate well below 50% of their capacity. This doubtless represents a serious threat to the regional industry.

The United States spearheads a new market

The United States did not lag behind Europe in the industrial development of biofuels, especially, in the beginning, with the development of ethanol for use in blends with gasoline. This made sense given that the country's transport depends to a large extent on gasoline engines.

In 1988, after close consideration of the European experience, the US Department of Agriculture (USDA) and the American Soybean Association (ASA) began to examine the viability of producing soybean biodiesel as a substitute for fossil fuel. They involved academics in their purpose and, in 1990, the *Farm Bill*[11] set its commercial production in motion. Like the Europeans, the Americans also concluded that it was the best option for absorbing vegetable oil surpluses, although the main driving force was to ensure energy security.

In 1991, the first American soy-based biodiesel for commercial use was produced in Missouri. Its consumption was then promoted through an amendment to the 1992 Energy Act, which showed the financial support of the USDA for the bioenergy program.

Following the example of their European peers, in 1992 soybean producers created the National Biodiesel Board (NBB)[12] as the coordinating agency for research and development in the United States. It has played a critical role in the domestic and international advancement of the market, and key among its activities are the annual conferences, organized since 2004, with the participation of worldwide experts who discuss political, commercial and technical considerations for the industry.

11 US Farm Bill.

12 National Biodiesel Board, previously called National Soy Diesel Development Board.

After the development of the American market, rules for the highest standards of quality were defined for local biofuel production. In 2002[13] the first stringent requirements for national biodiesel were introduced, and in 2008, the standard adopted two separate specifications: one for diesel biodiesel blends equal to or lower than B5, and another for blends between B6 and B20.

Major incentives were put in place in the first decade of the 21st century, in particular through the 2004 Employment Act and the 2005 Energy Policy Act. An important component of the latter was the Renewable Fuels Standard (RFS), designed to promote the use of biomass-derived fuels and which requires a renewable identification number that is of critical importance when it comes to obtaining loans and marketing the product.

In the wake of the 9-11 attack in 2001, the US biodiesel industry grew significantly with the help of additional incentives granted by the Federal Government.

Government support and the ease to produce biodiesel led to the creation of garage factories for personal consumption under conditions of inadequate industrial safety that did not meet the requirements for automotive use or the technical standards necessary. Consequently, 2006 was a difficult year, with fires in these home factories, mainly as a result of inadequate methanol handling. Hence the decision by the NBB of launching a strong information campaign and requiring compliance with a safety code for the production and manipulation of this bioenergy fuel, in order to prevent future accidents.

Government support favored sustained growth in production, which rose from 2 million gallons in 2000 to 250 million in 2006, and then to nearly 800 million in 2011, creating more than 31,000 people directly employed in biodiesel in the country. The most controversial of all the incentives was the Blender Tax Credit, consisting of 1 dollar per gallon, regardless of the biodiesel concentration in the blends. That was the origin of the *splash & dash* practice for B99 (1% diesel and 99% biodiesel).

In 2007, the European Biodiesel Board (EBB) denounced the entry of subsidized American biofuel into the European market, creating unfair competition for local production. According to the EBB, the subsidy for the renewable fuel reached 200 euros per ton at one point, promoting another practice known as *touch and go*. This practice consisted of ships carrying biodiesel from Argentina, Malaysia

13 Called ASTM D 6751.

and Indonesia that would touch US ports where they were "splashed" with fossil diesel and thus became eligible for the subsidy.

In addition, in Europe the imported B99 benefitted from other incentives, creating another negative impact for local production and domestic marketing. In 2007, the EBB filed suit against the United States on a charge of *dumping* resulting from the subsidies, and it was only in mid-2011 that the European Commission allowed protective methods to be adopted in its industry.

Biodiesel: an opportunity for developing countries

Given that the production of biofuels needs raw agricultural materials, they have been recognized as an excellent opportunity in developing countries for reducing poverty and driving economic growth, in this way supporting greater rural wellbeing. Biofuel production contributes to increasing rural employment, higher income for farmers and improved quality of life.

Advances in the biodiesel industry did not occur only in the industrialized countries. Other countries such as Indonesia, and Malaysia, which was the main palm oil producer in the world at the time, also showed interest in this industry. In 1982, Porim[14] – as it was called then – conducted laboratory tests that resulted, two years later, in the commissioning of an oil palm biodiesel pilot plant. Next, it satisfactorily conducted various laboratory and road tests with several diesel engine vehicles. One decade later, the same agency, now called the Malaysian Palm Oil Board (MPOB), had already developed a production technology for palm biodiesel use in the winter.

Biofuel production in Malaysia developed along two paths: the first focused directly on trans esterification, and the second focused on the direct use of refined vegetable oil blended with diesel, also known as "Envodiesel", which the automotive industry strongly opposed. Given its low cost, its development and implementation were high on the government's priority list, above any other fuel using palm oil as a raw material. However, the multiple problems found in practice with Envodiesel, led the government to relent and re-open its eyes on biodiesel.

Consequently, it was only in 2005 that the Malaysian government adopted a national policy for the production and use of biodiesel (currently, the country has a B5 blend). At that time, once the first commercial biodiesel plant came into production,

14 Now called Malaysian Palm Oil Board (MPOB), it is the oil palm research institute in Malaysia.

the government committed 6 million tons of palm oil for biodiesel production with the goal of making the country the largest world producer of this biofuel. By 2007, 92 factory construction licenses had been approved, with a total production capacity of 10.2 million tons. However, by the end of 2010, only 25 of those factories had been built, with a capacity of 2.6 million tons, but 11 with an effective use of only 20% of their total potential.

The main problem in launching the biodiesel program is explained on the basis of the high production costs and the inability to compete against diesel, which is strongly subsidized by the government. Moreover, demand for the biofuel is not sufficiently high to create a sustainable industry, considering that diesel-fueled private vehicles account for only 5% of the total, and public vehicles cannot make up for the difference. All this, together with the pressure and negativism of the oil companies to equip their supply plants and service stations with the necessary infrastructure for handling the blends, has made it difficult to introduce a biodiesel program.

Consequently, the Malaysian government has to take a clear stance regarding its biodiesel production. Without doubt it has to focus on the international market and the demand from the European countries in particular, ensuring, of course, that its biodiesel is accepted by the European Commission under its emission reduction policy.

Indonesia, for its part, has played a critical role in the international market for agro-energy because, besides subsidizing its production, it has set up a differential export tax in relation to crude palm oil. In 2010, this resulted in the placement of nearly 80% of its production outside its borders, principally in the Netherlands, Italy and Spain.

It is worth noting that palm biodiesel has not had a smooth ride in the past two years, mainly because the RFS2 from the United States prevented its local use by means of tariff barriers designed to protect the domestic industry. Arguments in the United States revolved around the deforestation, brought about in Malaysia and Indonesia, by the production of the raw material. This deforestation in itself, releases a significant amount of greenhouse gases into the atmosphere. However, it is clear that oil palm, soy or rapeseed biodiesels are not the source of environmental damage but rather it is the way in which they are produced. Consequently, it is up to producers and governments to make sure that production is sustainable and friendly to the environment and the ecosystem.

In Latin America, Brazil with its thirty years of experience producing ethanol, set out along its path of biodiesel in 2000, taking advantage of its position as world leader in vegetable oils, in particular soybean oil, a position which shares with Argentina.

Although Brazil had already positioned itself as the main biofuels producer, Argentina took over this leadership, after five years of commercial production of soybean biodiesel. In 2011 it became the third world producer and largest exporter to Europe, with close to 1.6 million tons. Underlying this success were government incentives, as well as a much lower export tax than the one imposed on crude soybean oil. By 2010, with 29 operational plants, production was at 2.4 million tons, with an expected increase to 3.8 million tons in 2012, although only one third of that production is used locally in mandatory blending of biodiesel with diesel.

As for Colombia, the number one Latin-American producer of palm oil and fourth in the world, its adventure along the path of renewable fuel development began with the enactment of Law 693 of 2001 that made it obligatory to use alcohol-based fuel in blends with gasoline. Three years later, Congress passed Law 939 of 2004 that granted benefits for late and long yields crops, opening the way for biodiesel.

The pillars supporting the national biofuel program rely on the diversification of the energy mix, the energy self-sufficiency, the environmental improvement, and the creation of rural jobs. In 2008, a mandatory B5 blend was implemented for diesel–engine vehicles, with a gradual increase up to an average of B8 in 2011.

With six active palm biodiesel plants[15] and a production capacity close to 500,000 tons, Colombia is the only country where the compulsory blend is higher than 5%.

In 2009, the Colombian oil palm producers launched a campaign to promote biodiesel.

15 All, except one of them, are integrated in the agricultural chain (Data up to May 2012).

The world agro energy market: the big debate

Biofuels have been categorized according to "generations" that differ depending on the raw material source and the production technology.

First generation biofuels, including biodiesel and ethanol, are derived from food sources (e.g. corn, soy, sugar cane, palm oil) using technologies like fermentation (for ethanol) and trans esterification (for biodiesel).

Second generation biofuels are derived from raw materials that cannot be used for foodstuffs. They are obtained through conventional technologies (like the ones used for first generation fuels) or through thermochemical processes (for the production of liquid synthetic biofuels). This is the case for both jatropha and poplar, along with various others. Algae are also being considered as a source of second generation biofuels because they do not compete for productive farming soils and, although they are grown in shallow ponds, their yields are far greater than those of other raw materials.

The jatropha is a bush that produces oil which is poisonous. It has been placed above other agro energy fuels in preliminary studies because of its high oil yields per hectare sown and its very scant need for water. There are also experiments conducted by aeronautical companies that have used it in their engines in the form of biodiesel[16], placing it in the spotlight for investors and governments all over the world. Such is the case of India, which has taken the lead as a primary exporter of jatropha seeds.

However, there still is not enough information to place such high stakes on jatropha, and third world nations would be better advised to stay put until the ongoing research provides reliable information showing that jatropha can actually be considered as a successful large-scale sustainable crop. The many setbacks in its industrial production are no secret. In fact, there have been resounding failures like that of BP, which invested more than 1 million dollars, prompted by its initial interest. However, in 2009, it decided to leave the business as it found that although the crop can grow in marginal soils, its yields depend mainly on the quality of those soils.

16 On December 30th, 2008, Air New Zealand was the first to test a blend of 50% jatropha biodiesel and Jet A1 fuel in a commercial aircraft, a Boeing 747–400 equipped with Rolls Royce RB211 engines. Air New Zealand, Boeing, Rolls Royce and Honeywell UOP carried out the experiment together, reporting it as successful.

In turn, third generation biofuels use production methods similar to those of their predecessors, with bioenergy crops specifically designed or adapted (usually by means of molecular biology techniques) to improve biomass conversion to biofuel. Examples are the development of integrated-cellulose corn and low-lignin trees that result in lower pre-treatment costs and improved ethanol production.

Finally, fourth generation biofuels go one step further. The key is "carbon capture and storage", both during processing as well as in the raw material, which is adapted not only to improve processing efficiency but also to enhance carbon dioxide capture as the crop grows. Likewise, processing methods (mainly thermochemical) combine with capture and storage techniques in order to channel the carbon dioxide generated, towards the geological formations.

Consequently, energy reconversion is happening at dizzying speeds with certain first generation products such as biodiesel. At the same time, it is also possible to implement, economically and efficiently, other clean energy sources such as solar and wind power, which like hydrogen would not create controversy.

Solar or photovoltaic panels capture and store sunlight and heat that are then transformed into electrical energy. Although costs are still high, they have been decreasing over the years. The main producer is Japan, followed by Germany.

On the other hand, the use of wind power for producing energy is growing exponentially, improving rural income on the wind farms[17] where wind energy is generated. However, there are criticisms of this form of energy including noise pollution from the sound of the windmills, the intermittency of the wind and the high mortality of birds that collide against the blades. Wind energy could be used for water electrolysis in order to produce hydrogen.

In theory, the most effective energy reconversion would be the adoption of hydrogen as the primary source of energy in the world. This would avoid consumption limitations that might compromise mankind's technological, economic, cultural or scientific development. There is no doubt that hydrogen is one of the most abundant and versatile elements in nature. In practice, however, this source cannot be considered as the easy, sustainable route because of the lack of appropriate or financially viable technologies at the present time, and because of the huge cost of the infrastructure required for its production, transportation and distribution.

17 Many of the largest wind farms are located in the United States. The Roscoe inland wind farm is the largest in the world, with a capacity of 781.5 MW of power. The largest marine wind farm (Walney) is located in the United Kingdom and has a capacity of 367 MW.

It has multiple applications, mainly in the synthesis of ammonia. However, it is also used in batteries for electric engines, oil refining operations like hydrocracking, and sulfur elimination. In addition, it is employed in hydrogenation of non-saturated liquid vegetable oils to obtain solid fats; and also for the manufacture of organic chemical products such as rocket fuels, and as propellant for nuclear energy fueled rockets.

For the time being, biodiesel is the renewable energy alternative found most commonly on the market. At present, this agro energy fuel accounts for 16% of world consumption of vegetable oils; however, assuming all of the vegetable oil was to be used for the production of biodiesel, it would only cover 3% of fuel requirements.

In the midst of the growing pains of a new world industry, there were opponents who promoted a global debate known as *Food vs. Fuels*, which gained momentum when the prices of foodstuffs skyrocketed, grain reserves dropped, and the price of oil increased to more than 130 dollars per barrel.

It is important to mention that, between 2003 and 2008, nominal prices of energy increased by almost 230%, agricultural product prices doubled and those of fertilizers increased four-fold. All this was happening while a series of adverse climatic conditions dealt their blows relentlessly on rural activities.

One of the consequences of the rising prices of crude oil was the associated increase in the cost of crop production. This resulted in a reduction in supply that, coupled with droughts and floods caused by climate change, plus a higher demand from emerging countries, led to a huge increase in food prices. The combination of all these factors triggered panic about a potential threat to food safety, impaired access to food by the poorest populations, and shortage of land for food crops.

The debate became most heated when the biofuel industry was blamed for the increase of more than 50% in the price of corn *tortillas* in Mexico. So much so, that the World Bank published, at the time, a document describing the main driving force of price increases in agricultural products since 2002, and concluded that the most important of all was the demand for biofuels, as well as the high cost of energy.

Two years later, the same organization had to rectify its position in a new paper entitled *The boom of commodity prices in perspective, 2006/2008*. In this document, the World Bank stated that agro energy fuels did not have as great an impact as initially predicted, and that rather, for the poorer countries, it was

investor speculation that had actually had a greater impact on agricultural commodities because of inflationary effects on food prices with the resulting negative impact on low-income household spending which could represent more than 50% of their budget.

In summary, current prices of certain agricultural raw materials move in tandem. Moreover, an important characteristic, particularly of vegetable oils, is that prices started to correlate with those of oil, as of 2003, given the high demand for bioenergy production and the fact that vegetable oils now incorporated a new feature: energy production. This means that any change in fossil fuel prices is reflected immediately in vegetable oil prices.

The food vs. biofuel debate was followed by another one on the indirect change in land use and its contribution to greenhouse gas emissions. The discussion revolves around the argument that lands previously used for food production are now being used for producing inputs for biofuels, imposing relocation and clearing of new land for food growth, with the resulting effects on climate change. Another consequence is competition for land or for soil use, with the resulting increase in its value and rising prices of agricultural products.

Curiously this debate appears to disregard the reason for the emergence of agro energy fuels: In the first place, because of the fossil fuel high prices, and after, for the ability of agro energy fuels to become an option for reducing greenhouse gases produced mainly by the transportation industry. However, opponents have challenged their true role in achieving the latter, and hence the development of tools for measuring their contribution.

These tools include models of life-cycles that try to show the reality of energy balances, among them the indirect effects which are difficult to measure and which are not analyzed in the case of fossil fuels. There are those who suggest that fossil fuel life-cycle models ought to consider, for example, the way extraction affects the land, as well as the environmental impact of oil spills. This would reduce existing methodological flaws in the comparison of emissions created by fossil fuels versus renewable fuels.

At the end of the day, and as will be seen in later chapters, these debates, promoted in particular by leading social and environmental NGOs concerned with the preservation of the ecosystem and the protection of the rights mainly of the indigenous people, have led to an understanding with biofuel producers, where the idea is not to curtail production but rather to ensure that it is sustainable, regardless of the raw material used.

Noteworthy in this regard are initiatives such as the Roundtable on Sustainable Biofuels (RSB). Under the leadership of the Energy Center of the Federal School of Technology in Lausanne (EPFL), it developed, in 2007, the first version or "draft zero" of the principles and criteria for biofuels sustainable production.

The discussion is ongoing at this time, but it is expected to become less as technology and cost limitations of "second generation" biofuels and of other renewable forms of energy are overcome.

The geopolitics of biofuels

Ultimately, world development of biofuels came about as a result of political decisions based on strategic objectives, the most important being energy security, rural development, climate change and, even, improved trade balances between countries.

In order to reach those objectives, countries implemented measures designed to boost investors and support them in their efforts to lower production costs. They ranged from quantitative measures – mandatory blends and, in certain countries, export quotas – to qualitative measures – such as the establishment of production standards and technical barriers, especially in Europe and the United States – to economic measures – including financial incentives such as tax exemptions, fiscal credit, direct production support, and export subsidies, to mention but a few.

There is no doubt that the reason behind the vast majority of armed conflicts in the world has been control over natural resources, including oil, which has been at the core of world politics and of the security of the great powers. According to the Organization for Economic Cooperation and Development (OECD), developed world has to import almost two thirds of its oil comsumption, being the United States the biggest consumer.

The Energy International Agency (EIA) states that the global demand for energy will grow by 50% over the next thirty years, and that of liquid fuels will grow by 55% over the same period. This means that the concentration of 75% of oil reserves in five countries[18] shows the danger in which fossil fuel-dependent countries find themselves. Hence the move by developed countries like the United States and some European nations towards lessening their dependence.

18 Saudi Arabia, Iraq, Iran, Kuwait and Venezuela.

This they are doing precisely through the development of biofuels which, protected by their social and environmental essence, are changing the world's geopolitical stage. There is already an overlap between the map of certain agricultural commodities and the energy maps in countries that would never have been thought of as producers of their own energy, and even less as energy exporters. The world's agriculture is redefining itself and reaching unimagined levels as a result of its new role, which has the large added challenge of feeding 8.45 billion people by 2030, in the face of shortage of the required resources, i.e., land and water.

Indeed, the world is posed for the quest of clean and sustainable energy efficiency, and the research and development needed to accomplish this goal requires a significant economic investment. In fact, countries like the United States, Germany and Japan together account for 62% of the world's spending that has been destined for this purpose.

For the time being, Latin-American, Asian and African countries, in particular those closer to the tropics, have advantages in the production of biofuels, although investments for the development of this industry will certainly come from the wealthy countries.

The problem lies in their scant economic resources that put them in a position of having to sell the right to exploit their land to the "best bidder", perhaps in the hopes that, with renewable energy, they may join the circles of international power. Jacques Diouf, former FAO director warned: "Western States and enterprises are intervening millions of hectares of farming land in developing countries in order to secure their long-term food supplies",[19] but it must not be ignored that they are also securing their energy supplies in this way.

Considerable amounts of money have gone to the purchase of land in Asia and Africa for the development of biodiesel production projects. To illustrate the situation, it is worth mentioning that one of the goals of the Tanzanian government, for example, is to attract this type of investment to the country. In this way, the British company Sun Biofuel Tanzania acquired 9,000 hectares in the Kisarawe district. In Mozambique, applications for land purchase represent twice the area dedicated to food production.

19 *El Tiempo* newspaper. "Lucha de países ricos por controlar tierras fértiles en el mundo", January 2nd, 2012.

However, India is the country that has launched the strongest campaign for the promotion and establishment of jatropha plantations through its national fuel policy that dictates that 20% of domestic diesel demand will be derived from plant crops. However, some regional critics have claimed that planting this oil-producing bush violates tribal rights in certain Indian states by limiting their ability to decide how to use their lands; in some cases, the crop has been established against the will of those tribes.[20]

So, it is in these emerging developing economies where there are still significantly large areas of arable land. Hence the importance of FAO's study on *Land resource potential and constraints at regional and country levels*, according to which there are approximately two billion hectares that could be put to agriculture (close to 500 million should not be farmed for environmental reasons). This study was about identifying the potential area for crop growth and classifying the countries according to whether they had low, medium or high land availability. Colombia was ranked among the top six with high land availability.[21]

Oxfam, a non-government organization, also states in one of its reports that "Colombia is one of the most interesting countries for foreign investment, both because of the qualities of its soils as well as its water",[22] hence the government's responsibility to ensure that it does not transfer territorial control to foreign hands whose only purpose is to meet the needs of their own people at our expense.

There is no doubt that Colombia is a privileged country, with soils that are suitable not only for food production but also for energy production. According to the Ministry of Agriculture and Rural Development, Colombia's continental surface is 114 million hectares, of which approximately 55 million hectares have agricultural potential. Of these, 4.9 million correspond to the existing farming frontier with an actual potential of 21 million hectares. Cattle raising uses 38 million, when the actual potential is only 20 million hectares, and although 14 million hectares can be used for forestry, only 350,000 are actually planted.

The possibilities offered by these lands are critical for President Juan Manuel Santos Calderon and his administration, considering that sustainable productive projects will act as a driving force for growth and for the social and economic

20 Research Foundation for Science, Technology and Ecology, 2007.

21 Together with Angola, the Democratic Republic of Congo, Sudan, Argentina, Bolivia and Brazil.

22 *El Espectador* newspaper. "Colombia entre los más vulnerables del mundo por compra y venta de tierras". November 23rd, 2011.

development of the rural population. Additionally, such projects will allow the victims of violence to return to their rural homes under the framework of the Land Restitution Law.

Using inclusive projects developed by and for Colombian nationals may not only help the country become an energy and food power, but will also ensure that the income derived from those activities is reinvested internally to promote the growth of the national economy, through the links between agriculture and all other sectors of the economy.

Consequently, one of the tools of the Santos administration for placing Colombia on the world stage is the Rural Development bill that is now under discussion. This law will provide a roadmap for sustainable rural growth consistent with the country's capabilities, ensuring that all benefits come to the Colombians. Not having this rule approved will contribute to further foreign interests that will do little or nothing to drive true economic growth for the rural population and most likely, with their large capital, they will reap profit in the face of world shortage.

Photography: Courtesy of Aceites Manuelita S.A.

Biodiesel plant, Aceites Manuelita S.A.
Location: San Carlos de Guaroa, Meta. Capacity: 120,000 t/year. Inauguration: June 2010

Chapter 2

Dawn in the plantation of Palmas Oleaginosas Bucarelia S. A.
Photography: Toro, F. (2009).

Colombia strongly embraced the biodiesel revolution

Laws are not harsh or lenient; they are unmovable and, as such, foreseeable, fixed pictures within which it is up to mankind to do the best it can to plan its own destiny.
André Maurois

Mauricio Acuña Aguirre, chairman at the time of the Fedepalma Board of Directors,[1] told the then President of the Republic, Álvaro Uribe Vélez, that if the project for producing biodiesel from oil palm became a reality – so that oil palm would no longer only be a food but also a fuel – it would be as if "the eleven thousand virgins" had appeared not only to the oil palm sector, but also to the whole country.

Those were his words in 2005, during the closing session of the oil palm growers' congress held in Santa Marta. Although the legend about the "eleven thousand virgins" - actually a group of only eleven martyr maidens –was thought to be universally true, because of repeating a historical error for centuries, doubtless the analogy was quite meaningful at the time, because it seemed as though the stars were aligned for Colombia to enter into the biofuels' era with all its force.

The momentum had started the year before, in 2004. The impetus of the National Government, Congress, the private sector, the academics and the oil palm agribusiness was at its highest, with all the stakeholders working hand in hand to find the best viable path for the biofuel business in Colombia.

1 Established in 1962, the National Oil Palm Growers Federation represents and furthers the interests of oil palm growers and palm oil producers before the Government and society as a whole.

Oil palm is an important source of jobs, energy and reduction in environmental impact. Photography: Toro, F. (2008).

The Government's idea revolved around three aspects: social development, environmental protection, and energy production. For the President, biodiesel produced from palm oil provided an opportunity to boost agricultural activities and create an important source of jobs, generate positive environmental impacts, and achieve interesting reductions in the traditional dependence on oil. Consequently, he spared no effort in finding and offering the types of incentives that could make the idea come to fruition. He was convinced that the project would result in great gains for his government policy, one of which was to recover investor trust in Colombia.

The first minister of Agriculture and Rural Development of the Uribe administration was Carlos Gustavo Cano Sanz[2], who was perhaps the first official to introduce the Government to the issue of global warming. He was intent on employing unused land in the eastern plains as huge "CO_2 sinks" through reforestation, in accordance with the guidelines of the Kyoto Protocol. He was also the architect of the "rebirth of the upper Orinoco basin", an ambitious program consisting of using these lands for production projects such as oil palm, rubber, Caribbean pine, and other species. These projects were set up in Carimagua[3] and La Libertad, two state-owned rural farms dedicated to agricultural research and technology transfer where permanent crops had already been established, as well as on some farms belonging to the Colombian Air Force.

Cano referred to the "ministries of agro energy", the title he assigned to those of Agriculture and Rural Development, Mines and Energy, Environment, Housing and Territorial Development, who he called upon, urgently, to place Colombia at the forefront in the biofuels' era.

He created a form of partnership with Luis Ernesto Mejía Castro,[4] Minister of Mines and Energy at the time, who was instrumental in crafting the regulations and standards required to ensure the country's leading role in biofuels. Curiously enough, Mejía, as vice-minister of Mines and Energy for the previous administration under President Andrés Pastrana, had argued against the law on fuel alcohol, considered detrimental for Ecopetrol S.A. at that moment.

In terms of the boost to agricultural activities, the Government was certain that productive alliances between large oil palm stakeholders and smallholders could be the ideal mechanism for increasing the planted area. Amongst the incentives the leading role was given to what was politically called "democratic security",

2 Carlos Gustavo Cano was a Minister in the Uribe administration until February 2005, when he took office as co-director of Banco de la Republica (Central Bank). His successor at the Ministry was Andrés Felipe Arias. who resigned in February 2009 to aspire to be the candidate of the Colombian Conservative Party at the 2010 Presidential elections.

3 The Carimagua farm was assigned to people who had been displaced by the violence, but Minister Andrés Felipe Arias tried to change the initial decision in order to assign the land to private investors, arguing that they would make better use of it (planting oil palm for fuel, for example) and that this would generate greater gains for the country and for the internally displaced as well. His proposal was unsuccessful and became a political scandal in 2008.

4 Luis Ernesto Mejía Castro acted as Minister of Mines and Energy during the first four years of the Uribe administration (2002-2006). In the same Ministry, he had been the vice-minister of Hydrocarbons and Energy during the final years of the administration of President Andrés Pastrana Arango (1998-2002). His successor was Hernán Martínez Torres.

aimed at bringing peace to the rural areas. And it was effective, as can still be seen today, in the traditional oil palm growing areas, where there is a strong sense of belonging that keeps the farmers producing on their land. In the meantime, oil palm was welcomed in many other regions as a good substitute for illegal crops, making it possible to involve former guerrilla members from Farc and Eln in oil palm production, giving them an opportunity for a new life within the law.

In terms of energy supply, the situation was quite uncertain in Colombia. The constant decline in reserves, compounded by the absence of new discoveries, resulted in lower oil yields. External factors, in particular high international prices of oil and natural gas, made things even worse, giving a greater sense of urgency to the search for new sources of energy in the vast and insufficiently explored universe of alternative fuels.

Still more worrisome was diesel supply. By then, it was clear that Ecopetrol S.A. was having great difficulties providing this fuel, primarily because of the reduction in confirmed reserves belonging to the nation, the high sulfur content in locally-produced diesel, which was much greater than the international levels allowed, and the need to expand local installed capacity for diesel production.

Under these circumstances, Colombia had to import increasing quantities of diesel every year. At the time, approximately 5,000 barrels per day were being bought in foreign markets (250,000 tons/year), and official forecasts were 30,000 barrels per day by 2020 (1.5 M tons/year). In other words, dependence on imports of this fuel would increase from 7 to over 30% in less than 15 years.

Government agencies, therefore, had developed great interest in alternative forms of energy that could partially solve their concern for the relative imbalance in the energy mix. This triggered the process of setting up the National Biofuels Working Group that came to fruition in 2004, with the Group starting operations early in 2005 as the forum for discussion between the public and the private sector, including the academic community. The goal of the discussion group was to reach an agreement regarding the technical, economic, logistic and environmental bases needed for the future development of this theme in the country.[5]

5 The National Biofuel Roundtable operated until March 2008, when the Conpes document 3510 of that year created the Inter-sectorial Commission for Biofuel Management as the agency appointed to coordinate the process of formulating and implementing public policy on biofuels. In this new version of the discussion forum, now chaired by the Ministry of Agriculture and Rural Development, the private sector is not present. The private sector was previously represented by biofuel producers, academics, the industrial sector – through the National Business Association (ANDI, for its acronym in Spanish) - and the automotive sector, among others.

Created as a joint initiative between the Ministries of Environment, Housing and Territorial Development, and Mines and Energy, it focused on the work of five groups, coordinated as follows:

- Raw materials: Ministry of Agriculture and Rural Development.
- Standardization: ICONTEC[6] and the Vicepresidency of Refining and Petro chemistry of Ecopetrol S.A..
- Technical tests: Colombian Oil Institute (ICP).
- Marketing/logistics/financing: Ministry of Mines and Energy.
- Science and technology: Colciencias.

This forum for discussion on how to build the guiding framework, for laws and regulations, plus the synergies between the various biofuel stakeholders, would eventually become the foundation for developing and launching the regulations that began to govern the emerging biodiesel industry in Colombia, and show the way for business entrepreneurs willing to invest in this new undertaking.

In turn, Congress was also involved in an interesting dynamic. There were many enthusiastic senators and representatives ready to consider any initiatives put before them with great conscientiousness and alacrity. At the time, they were actually debating the government bill designed to stimulate the production and marketing of biofuels derived from plant or animal sources for use in diesel engines, which a few months later became Law 939 of 2004.

Oil palm growers, on the other hand, as the obvious producers of the raw material, had already done their own research about potential niches and marketing mechanisms for the placement of their growing palm oil surpluses. And rightly so: the possibility of selling significant volumes of palm oil to the domestic market for the production of biofuels to replace diesel imports and become a strategic asset in the national energy mix was more than enticing. They had heard that if the 135 million tons of vegetable and animal oils produced in the world in 2004 were to be used exclusively for the production of biofuel, they would only account for about 3% of the global demand for diesel. That same year, more than 3 million tons had been used for biodiesel.

6 Colombian Technical Standards Institute.

In 2004, with an annual growth rate of 18.8%, the Colombian oil palm sector was exporting at unprofitable prices, hence their initial fear of jumping to accept President Uribe's bold proposal of doubling the planted area.

So much so, that the then Chairman of Fedepalma, César de Hart Vengoechea, reminded his colleagues and the President of the results of a study commissioned by Fedepalma on the financial feasibility of the project. The study showed that the production of palm biodiesel would be profitable only when oil prices increased above $35, and palm oil prices reached a certain level.

He was issuing a warning about the risks of basing, during temporary circumstances, such a long-term project, and about what it meant to increase crop areas in the light of the fact that the Colombian oil palm sector was not competitive. "Only competitive growth is good", he stated.

Such was the situation of energy sources in Colombia and of the oil palm agribusiness back in 2004, when President Uribe's enthusiastic promise set in motion all the regulatory, legislative and government machinery to vindicate as a driving force for national advancement, the most productive oleaginous plant on the planet: oil palm, of which Colombia is the top producer in America and fourth in the world..

A project on the move

The President kept his promise year after year, and the stage for taking stock was the oil palm growers' congress organized in a different city of the country every year. President Uribe attended all of them with impeccable punctuality.

The yearly appointment of the growers in 2004 had taken place in June, and Law 939 had already come to light by December of the same year. It was the first building block for the biodiesel business in Colombia. The primary objective of this government initiative was to foster the production and sale of vegetable or animal-derived biofuels for use in diesel engines,[7] as well as the production of its raw material. To achieve this goal, net income generated from taking advantage of late and long

7 Law 939 defines biofuel of vegetable or animal origin for use in diesel engines as any liquid or gas fuel derived from a vegetable or animal source that can be used in combustion processes, which complies with the definitions and quality standards set forth by the competent authority, and which is designed to become a total or partial substitute for fuel used in diesel engines. They include bioethanol, biodiesel (methyl ester), bio methanol, bio dimethyl ether, dimethyl ether, synthetic biofuels, bio hydrogen, and crude vegetable oils.

yields crops, such as oil palm amongst others,[8] would be tax exempted, provided these crops were planted within ten years following the enforcement of the law. Likewise, locally produced biofuel of animal or vegetable origin for use in diesel engines in blends with diesel fuel was also exempt from the payment of sales tax, the price premium tax, and the global tax applied to diesel fuel.

The government also established that diesel fuel for domestic use could contain biofuels of vegetable or animal origin, only of the qualities determined by the Ministry of Mines and Energy, the Ministry of Environment, and Housing and Territorial Development.[9]

Armed with these achievements, Álvaro Uribe Vélez reported back to the producers, during their 2005 oil palm growers' congress, on the actions undertaken by his administration, so as to encourage them to plant more and decidedly bring Colombia into the biodiesel era.

He also reminded his audience of the general incentives that also had a positive impact on the oil palm sector, such as the elimination of the VAT on capital goods purchased by the largest exporters, and the elimination of certain requirements to qualify as such. Moreover, the VAT paid for purchased capital goods was being returned to all the companies, regardless of whether they were large or small exporters; also, import duties on capital goods had been eliminated.[10] Besides all these measures, the Uribe administration kept other mechanisms in place, including collective loans, the Agricultural Guarantees Fund (FAG, for its acronym in Spanish),[11] and subsidies like the rural capitalization incentive (ICR, for its acronym in Spanish).[12]

8 Cocoa, rubber, citrus and fruit trees.

9 As of mid-2012 it became the Ministry of Environment and Sustainable Development.

10 Except for those produced in the Andean Community of Nations (CAN, for its acronym in Spanish), i.e., Peru, Ecuador and Colombia. Venezuela was a member until 2006.

11 Law 21 of 1985 created the Agricultural Guarantees Fund (FAG), which was later modified in 2000 by Tax Reform Law 633 that broadened its scope to include medium and large production projects, as well as alliances between smallholders and other producers within the general technological restructuring and modernization framework defined by the Ministry of Agriculture and Rural Development.

12 Granted to producers who had financed at least 40% of their projects using Finagro resources. Its main objective was to promote rural restructuring and modernization, and to support strategic alliances among producers. This incentive was designed to benefit projects carried out with smallholders associations (at least 20 associates) or strategic alliances. Finagro is the Fund for Agricultural Sector Financing, created by Law 16 of 1990 as a national agricultural loan system.

The President was eager to see the biodiesel project rolling. Therefore at the same time as he made his efforts, he demanded similar actions from the oil palm growers, having sensed pessimism in the speeches given by their Federation leaders.

Perhaps the President's great diligence was motivated by the fear that, such happened with the ethanol-gasoline blending project, this one would not take off fast enough. Indeed, although Law 693 of 2001, "also known as: law on fuel alcohol", had been approved by former President Andrés Pastrana Arango,[13] by the time Álvaro Uribe Vélez came to power it looked as though it would remain only on paper because there were no companies willing to produce ethanol, considering it to be a non- profitable operation. The Uribe Administration had to send signals to let them know otherwise, and took steps such as eliminating the VAT for this product, together with the national biofuel tax.

As for the oil palm growers, their concern that year had to do with the absence of regulations that would make it obligatory, or at least stimulate the demand for blends of certain percentages of palm biodiesel with diesel fuel.

They were therefore invited by the government to work together to accelerate the development of a regulatory framework. However, the then Minister of Mines and Energy, Luis Ernesto Mejía, did not hesitate to warn them that, regardless of whether the blends were technically viable, it was necessary to look for financial viability, and that viability was dependent on the market, in their case, the motor vehicle market.

The problem stemmed from the fact that the motor vehicle manufacturers were refusing to give guarantees to their clients who used blends, and who would have previously been given these guarantees, through long-term testing,[14] that their vehicles would not suffer damages. Obviously, the consumers did not want to lose their guarantees and so refused to use the blends.

In any case, a blend of 5% biodiesel with 95% diesel fuel would not be an issue to begin with, because the same blend was not even considered biodiesel but rather "regular" diesel in Europe.[15]

13 President Pastrana had refused to approve the law, which he considered unsuitable for the country, but the Constitutional Court declared it legal, and the President had no other choice than to sign it.

14 For additional information, see Chapter 4 of this book.

15 It is worth noting that fossil diesel in Europe at the time had 30 parts per million of sulfur while Colombian diesel had up to 4,000 parts per million. Consequently, the resulting blends would be very different in Colombia. Moreover, biodiesel in Europe is derived from rapeseed and not from oil palm.

At the time, regulations about the characteristics required for Colombian biodiesel were being prepared, and would come out in the following July. They would serve as a basis for the study of the standards of quality that would regulate biodiesel-fossil diesel blends.

But the oil palm growers persisted, and the Minister of Mines and Energy, who told them that he had attended their congress to take responsibility, told them that they should not focus on biodiesel as the only option but look into other options for their product, although he was well aware that biodiesel was already a reality.

> Grow your plantations because the United States market is available; because biodiesel has come to stay; because there are options in oleo-chemicals. Grow your plantations because there are many alternatives. Biodiesel is one, a very important one, but it is not the only one. Be more creative, and don't just rely on us making the regulations.

President Uribe was not in agreement with his Minister and in his very characteristic style, he was adamant when he said:

> Without the small door of biodiesel, oil palm growers will come to a standstill. We need to open that door for them in order not to put the breaks on oil palm planting. I do not believe that they are in a position, at the present time, to take the lead in research for the industrial use of palm oil. I believe that the role of the Government must be that of setting the pace and solving the blend issue as soon as possible.

In retrospect, the only favorable option for oil palm growers at the time was biodiesel; fortunately for them, it was the option that President Uribe had set his eyes on. Indeed, the United States market has not been available. Crude palm oil exports to the U.S., despite the absence of tariff barriers, have not been significant since 2005. The amount exported then was barely 4,740 tons and it has been dropping thereafter, reaching a low of 3,120 tons in 2011.[16]

The topic of oleo chemistry is still lagging behind in Colombia. The resources of the Federation are focused on highly important plant health issues such as bud rot, a disease that devastated oil palm plantations in Tumaco, previously an area of substantial oil palm production.

16 Colombian palm oil exports to the United States amounted to 5,907 tons in 2006; 8,160 in 2007; 15,825 in 2008; 4,951 in 2009; and 4,386 in 2010.

Free Zones are forged ahead

During the oil palm growers' congress in 2006, President Uribe raised the bar for the goals he had established back in 2004, halfway into his first administration. Now he wanted oil palm growers to plant 100,000 additional hectares per year. His dream was to arrive at approximately 600,000 hectares in the near future, considering that there are close to 3 million hectares in the country that could potentially be used for oil palm, without having to fell a single meter of jungle or forest.

The Colombian oil palm growers Federation has invested great efforts and resources in tackling bud rot disease. Photography: Piedrahita, H. (2010).

And he then reminded the oil palm growers of the incentives provided by his administration for the agricultural sector so that it could meet his expectations: tax incentives and the ICR to renew old plantations. Moreover, he assured his audience at the oil palm growers' congress that biodiesel factories would soon be given the status of free zones, and orchestrated the conceptualization of a Conpes document.[17]

17 National Council for Economic and Social Policy of the National Planning Department (DNP, for its acronym in Spanish).

The former was accomplished by means of Decree 4051 of 2007,[18] which set forth the requirements necessary to apply for a free zone. These included the ability to produce high economic and social impact on the country. The main enticement for a company to set itself up as a free zone was that it could do so in any place within the boundaries of the national territory.

It was not long either before discussions began on the Conpes documents for the oil palm sector and for biodiesel, and these were eventually finalized in 2007 and early 2008.

The latter[19] gave an overview of the biofuel in the world, as well as supporting the need to form a policy designed to promote sustainable biofuels production in Colombia, taking advantage of the opportunities for social and economic development afforded by its markets. The idea was to allow for the expansion of biomass crops[20] already sown in the country, and diversify the energy mix within a framework of efficient and sustainable production, enabling competition in the domestic and international markets.[21]

It formed the set of policy instruments designed to promote biofuels, through the National Development Plan, the establishment of a regulatory framework, and the implementation of fiscal and financial incentives. It also described the government's policy guidelines for sectors such as agriculture, research and development, infrastructure, and the environment, which influence the development of renewable fuels.

Additionally, it created an inter-sectorial biofuels management commission entrusted with the job of coordinating all public policy pertaining to liquid biofuels. The commission consisted of representatives from the ministries of Agriculture

18 This decree regulates Law 1004 of 2005 and sets forth the provisions for special permanent free zones for agribusiness projects, amongst other things. It states that the amount of the investment for agribusiness initiatives must be 75,000 minimum legal monthly salaries, or must generate 500 or more jobs in the agribusiness chain. Likewise, the law requires proof of the link between the special permanent free zone with its planted areas and the production of domestic raw materials for transformation.

19 "Policy guidelines to promote the sustainable production of biofuels in Colombia". Conpes 3510.

20 Biomass is sun energy converted into organic matter by the plants. Plants transform the energy of the sun into chemical energy through photosynthesis, and part of this energy that remains stored in the form of organic matter may be recovered by direct combustion or by transformation into fuel. Among the main sources of biomass are forest residues and agricultural waste.

21 The National Development Plan anticipated that, by August 2010, diesel distributed in 26 departments would contain at least 5% biodiesel. However, Decree 2629 of 2007, required raising the amount to 10%, in that same year.

and Rural Development; Mines and Energy; Environment, Housing and Territorial Development; Transportation, Trade, Industry and Tourism; and the National Planning Department (DNP, for its acronym in Spanish). Other public servants, regional authorities, agency representatives, national and international associations and private sector groups could also be invited to attend.

Finally, it stated that it was foreseeable that domestic biofuels production would be used exclusively to meet internal demand in the short term, but it also set the expectation that production surpluses in the medium and long term would be destined partially for the foreign market. Based on the argument of securing the international placement of biofuels, it recommended that Colombian biofuels should be differentiated on the basis of their environmental and social benefits. It also required that biofuels sold in the domestic market – either locally produced or imported – should meet the same standards as those produced for international markets.

In theory, the fact that a sector is made the subject of a Conpes document places it high among government priorities. In this case, biofuels have been given priority as part of the strategies for agriculture and energy, and they are identified as a sector with important potential among development policies.

For its part, the Conpes[22] document for oil palm had been released the year before. It revolved around five strategies: cost rationalization; improved yields in crop production and palm oil milling; access to markets; financing policy; and social and environmental responsibility.

It set forth the objective of adopting a policy designed to improve sectorial competitiveness and promote marketing of palm oil and its by-products in domestic and international markets. This would be carried out with social and environmental responsibility, and within a regulatory framework that would ensure legal guarantees for policy implementation.

By the end of 2006, the oil palm sector had planted 292,570 hectares and produced 714,308 tons of palm oil.

Over the following years, in its rush to demonstrate that biodiesel was a real possibility, the government opened a small pilot plant in Tumaco, producing biodiesel using national technology. The Colombian Corporation for Agricultural and Livestock Research (Corpoica, for its acronym in Spanish) was entrusted with

22 No. 3477 of 2007: "Strategies for competitive development of the Colombian oil palm sector".

setting up the plant, which would produce 2,000 liters of biodiesel per day. That production volume would supply power to more than 10,000 inhabitants in the municipality of Salahonda in the Department of Nariño.

Moreover, the government signed a cooperation agreement with the countries of the Puebla Panama Plan to provide technical assistance in the field of biofuels production, and offered to donate three domestically developed pilot production plants to Guatemala, Honduras and El Salvador.

However, none of these projects worked because, as the results showed, small scale garage-type plants were not appropriate for commercial operations in programs like those envisioned for Colombia and Central America.

Fedepalma had already warned about what could happen, and it believed that a more efficient use of the resources allocated to small pilot plants would be to direct them to research projects on raw materials and even biodiesel as such. Additionally, together with the resources provided through Colciencias to the universities, those funds could contribute to the sustainability of the program over time.

President Uribe also considered the opportunities for biodiesel in the international market, especially the United States, which had announced increases in its biofuel blends. He took advantage of the visit of President George W. Bush to Colombia in March 2007 to show, together with Fedepalma and Asocaña, the progress made by the country in that area.

Álvaro Uribe Vélez was unable to attend the oil palm growers' congress in 2007, 2008 or 2009, but he always made sure that his message was conveyed, and that he was made aware of what the producers had to say. To replace him, he would send his minister of Agriculture and Rural Development, Andrés Felipe Arias Leiva, and his minister of Mines and Energy, Hernán Martínez Torres, with whom he would discuss the progress achieved by the sector. The ministers always showed their willingness to work hand in hand with the private sector.

During the 2007 oil palm growers' congress, Mauricio Acuña, chairman of Fedepalma's Board of Directors, asserted that the agribusiness had indeed met the government's demands.

At the start of the Uribe Administration in August 2002, there were 170,000 hectares planted in oil palm, and by the end of 2008, the planted area had doubled; in other circumstances, such a feat, achieved in only six years, would have taken forty.

Numbers reflected good management: additional investments in the crop amounted to 1.75 trillion pesos, resulting in the creation of 55,000 new direct and indirect jobs in 78 Colombian municipalities where more than 200,000 hectares had been planted. A significant proportion had been developed under productive alliance schemes designed to improve the quality of life of some 4,500 smallholders and their families.

Despite all this, Mauricio Acuña complained that it was not easy for producers to purchase land, and he asked the Government to create the necessary conditions for expanding the oil palm frontier by having Incoder,[23] for example, reassess the mechanisms designed to provide effective access to land.

The biodiesel project resulted in 55,000 new jobs being directly and indirectly created in 78 Colombian municipalities. Photography: Ospitia, R. (2004).

23 Colombian Institute for Rural Development, attached to the Ministry of Agriculture and Rural Development. Its mission is to enforce agricultural and rural development policy, facilitate access to productive factors, strengthen territorial entities and their communities, and pave the way for the coordination of institutional action in the rural areas. All this was to happen under the principles of competitiveness, equality, sustainability, multi-functionality and decentralization, and with the ultimate goal of improving the quality of life in rural communities as well as the country's socioeconomic development.

Oil palm growers voiced their expectations that the bill of law on the rural regulation that had been submitted to the Congress would lift the restriction created by Law 160 of 1994 that limits land acquisition only to the beneficiaries of the agrarian reform when the size of the land surpasses the limits established for family agricultural units. They also pointed to the need for creating the right conditions to ensure that major investors could contribute to the achievement of the ambitious goals proposed.

The search for local markets for the growing palm oil production – which until a short time ago had no other options than to be exported in a harsh international market – would push the country to find a tailor made solution for biodiesel that would benefit all of those participating in the endeavor.

The oil palm growers federation informed the Government's keen interest in the biodiesel project, nine initiatives for production were already under way, with one plant already in operation and three additional ones to be opened in the first quarter of 2008. Based on the production capacity of these plants, the forecast was that close to 280,000 tons of biodiesel would be produced in 2008.

Along those same lines, they reiterated the importance of ensuring the mandatory use of the biodiesel-fossil diesel blend to make certain that the product would find a place in the market, just like the production of fuel alcohol had it. Acuña-Aguirre recommended that the National Government should urge Congress to pass the bill of law that was under its consideration regarding such topic.[24]

On the other hand, the expansion of the total installed capacity of the mills by 254 tons of fruit per hour required the supply of an additional 105 billion pesos on top of the 300 billion devoted to the development of biodiesel plants. During this period, investments amounted to 2.3 trillion pesos in crops, mills and biodiesel plants. However, during its 2008 congress, the oil palm growers pointed out that progress had to move faster if it was to catch up with the pace of the modern world.

Concerning the democratic security program, producers stated that it still had a long way to go, and expressed their open support for the Government in its task that however hard it might prove to be, had to have a successful outcome to ensure

24 However, the bill of law did not go through Congress as expected and had to be submitted twice. It was the bill of law 260 of 2004 in the Lower Chamber, and 193 of 2005 in the Senate, designed to overcome the hurdles that would stand in the way of transforming a potential opportunity into a sustainable energy option.

that the country could follow the path of progress and wellbeing in accordance with voters' wishes. To confirm this view, they pointed to the fact that the Farc, which used to justify its existence on the basis of political struggle and boasted about its power to intimidate through its terrorist activities, had been exposed as one of the major drug trafficking organizations, another of the big threats to peaceful coexistence, together with the paramilitaries.

However, the increase in domestic demand for palm oil for biodiesel production beyond 2008 required changes in the trade structure of the sector, given that it was estimated that the local palm oil market would grow more than double by 2010. Considering such a forecast, and in order to improve revenues for the sector, there was a need to make adjustments to exports, which had been booming over the past twenty years, so that the growing domestic demand could be met.

January 1st 2008 saw the dawn of the mass use of the B5[25] blend in the Atlantic Coast and the department of Santander, putting an end to the first stage of the National Biodiesel Program. The National Government, with the decisive backing of the oil palm sector, moved rapidly to structure the regulatory framework required for the development of biofuels, and of biodiesel in particular.

Moreover, biofuel earned the trust of the fuel consumers and other sectors, thanks to the successful completion, in December 2008, of the long-term testing of palm biodiesel in the mass transportation system in Bogota (Transmilenio).

By the time the oil palm congress met in 2010, Juan Manuel Santos Calderón was already the President elect. This time, outgoing President Uribe gave an overview of his administration's achievements in areas such as democratic security, investor trust and social cohesion, and highlighted the role of the oil palm growers Federation as a symbol of hope for the homeland. However, he regretted that the goal of planting 600,000 new hectares had not been accomplished, but recognized that it had been impossible because of the bud rot disease:

> The country has much more confidence that there are large areas of land suitable for oil palm. I am thinking about southern Bolivar and the San Lucas foothills. Eight years ago, the only thing you could find there were guerrillas, paramilitaries and coca. Today, there are close to 22,000 hectares planted in oil palm. What a big problem you have! Because in almost every region of Colombia the conditions are

25 The letter "B" stands for biodiesel and the number refers to the percentage of the product used in the blend with fuel oil. In this case, 5% palm biodiesel and 95% diesel.

favorable for sowing it and people know it. That is why I urge you to think, not in terms of 400,000 or 600,000, but in millions of hectares. Colombia can do it, we have the land, and we have the people. You are the business community and many Colombians wish to partner with you every day. Go out and do it!

A regulatory framework under way

In summary, the legislation and policy guidelines that set the pace were Law 939 of 2004, the oil palm related Conpes document 3477 of 2007, and the biofuels Conpes document 3510.[26]

From the technical standpoint, the ultimate measure that opened the gate for biodiesel in Colombia was the national technical guideline 5444 (NTC): Biodiesel specifications for use in diesel engines. It was created by the ICONTEC committee No. 186[27] in response to the suggestion of the oil palm Federation which, it is worth noting, took the lead, jointly with Ecopetrol's Colombian Oil Institute (ICP), in evaluating palm oil and biodiesel blends with diesel fuel.

What the Oil Palm Research Center (Cenipalma) and the ICP did was to characterize palm biodiesel, oil palm (crude, bleached and refined) and blends of these with regular diesel, premium diesel and hydro treated diesel, and then assess the blends of these oil palm-derived products with the different types of diesel.

The encouraging results were submitted to ICONTEC, which also used other guidelines as reference, including the international ISO, the American ASTM, the European EN, and the Colombian NTC.

There were heated discussions inside ICONTEC, partly because automotive manufacturers and importers were reluctant to accept biodiesel-diesel blends in Colombia, and refused to issue warranties to their buyers. But the positive results of the technical and scientific tests submitted by Fedepalma and Ecopetrol S.A.

26 See the annex for detailed information.

27 This permanent technical committee from the Colombian Technical Standards Institute (ICONTEC) consists of different stakeholder representatives of the biofuel industrial chain. It is coordinated by ICONTEC, which also plays the role of the Secretariat. Since it was set up and until NTC 5444 was issued, it was chaired by Christie Daza. At present, it is made up of representatives from the private sector (Fedepalma, Cenipalma, fuel distributors, Fedebiocombustibles, Asocaña, Cenicaña, and the automotive industry, among others) and public sector representatives (Ministries of Mines and Energy, Environment and Sustainable Development, and Transportation, among others). Academic representatives also have a seat, including Universidad de Antioquia and Universidad Nacional.

The Oil Palm Research Center (Cenipalma) has been supporting the sector for more than 20 years, and its technical work was instrumental in the biodiesel project.
Photography: Toro, F. (2012).

eventually convinced them.[28] Then, in August 2006, the characteristics required for the locally produced biodiesel to be used in blends with fossil diesel were published, and palm biodiesel passed the test with flying colors.

Later, Decree 2629 of 2007 that promoted the use of biofuels instructed that, as of January 1st, 2010, B10 blends would have to be used in the country. It also stated that every motor vehicle requiring fossil diesel would have to be conditioned to use at least a B20 blend in their engines as of January 1st, 2012. Unfortunately, the Santos administration modified the regulation and determined that, starting on January 1st, 2013, the Ministries of Mines and Energy, and Environment and Sustainable Development, in consultation with the Inter-sectorial Biofuels Commission, could establish compulsory biofuel blend percentages over 10 for use in diesel engines. In practice, this operates against blends increases.

28 See Chapter 4 of this book for details about the discussions.

At the same time, Resolution 182142 of 2007 stipulated that, as of January 1st, 2008, B5 blends were to be distributed in the urban areas of the Atlantic Coast. It also stated that refiners and/or importers would be those responsible for the 2% biofuel blend whilst wholesale distributors would be responsible for the additional 3%. Moreover, refiners or importers, blenders as well as fuel pipeline transporters, would be responsible for guaranteeing the quality of the biofuels and their blends with diesel, ensuring that they met the parameters established in the corresponding Resolution.

In turn, Resolution 182087 of that same year set forth the quality requirements applicable to the biofuel to be mixed with diesel, and its blends (B5).

However, regarding the financial aspects of the business, there are other regulations that come into play.

Noteworthy is Resolution 182158 of 2007, also called "Price structure for fuel oil mixed with biofuel for use in diesel engines", because it responded to the underlying need of taking into consideration raw material quality adjustments, as well as losses from the biofuel production process. It also reflected the need for updating certain parameters associated with production efficiency of the biofuel for use in diesel engines, using as a reference the variation in the behavior of inputs, services and equipment associated with the production process, including that of methanol.

The aforementioned resolution was modified by resolution 180134 of 2009 in terms of the fossil diesel price structure, in order to adjust the formula for biofuel producer income in accordance with the requirements of the Conpes document 3510. It was determined that the maximum income would result from the calculation of the highest of the following three prices:

- A price referenced against the cost of opportunity of alternative uses of the most efficient raw material used for biofuel production; in this case, it is calculated on the basis of the reference price for palm oil in the domestic market with the corresponding quality adjustments. Additionally, it will take into consideration the international price of methanol as a production input, plus a calculation for the production efficiency factor.
- A price referenced against international diesel prices, measured on the current basis used to establish domestic prices for locally produced fossil diesel.
- A minimum price that allows for lessening the consequences of substantial reductions in the previous two prices.

It is worth highlighting that already in the Santos Administration, modifications were introduced in some resolutions in relation to the methodology used to define the price structure described above.[29]

Other regulations set forth, on the one hand, a venture capital fund managed by Finagro to support productive initiatives, preferably in areas with limitations for private investments, prioritizing agro-industrial projects, including biofuels production. And, on the other hand, the mandate that, for fiscal purposes, fossil diesel blending with biofuels of animal or vegetal origin for use in diesel engines, would not be considered an industrial or production process.

Environmental regulations are summarized under Law 1083 of 2006 and Resolution 180158 of 2007.

The former ordered that, as of January 1st 2010, all permits granted to public passenger transportation companies for operation within the metropolitan, district or municipal radius will require the use of clean fuels in all vehicles. Likewise, this law states that, as of the same date, replacement of all vehicles used for public passenger transportation must be done with vehicles that run on clean fuels.

The latter determined which were clean fuels using the fundamental criteria of the content of the various components, with the goal of ensuring a healthy environment and minimizing risks for human health. Consequently, it lists the following: hydrogen, fuel alcohol, natural gas, liquid petroleum gas, biodiesel, diesel with up to 50 parts per million of sulfur, and reformulated gasoline.

In fact, it was during the Uribe administration that the whole cascade of laws, decrees, resolutions and standards needed to implement new projects for biodiesel in Colombia entered into force. Today, this sound pioneering regulatory framework ensures quality and protection for the final consumers, positioning the country as a world leader in biodiesel production and blending.

However, there are still hurdles to overcome in regulatory terms, especially relating to the consolidation of B10 blends in the entire territory. There are also technical challenges to overcome in order to increase biodiesel content in the blends, up to as much as 20%.

29 Resolution 181966 of 2011 introduced partial modifications to Resolutions 181780 of 2005 and 180134 of 2009.

Along these same lines, there is still a need to create legal and commercial conditions within the framework of the various free trade agreements under way in Colombia. These conditions must not only provide for the introduction of palm biodiesel in international markets, but also enable the increase in the biofuel percentages in local blends in agreement with the motorized sector and in accordance with present and future vehicle manufacturing technologies.

A new absent Government

Since Juan Manuel Santos Calderón took office two years ago on August 7th, 2010, there has been no single sign that may lead biodiesel producers to think that his administration will give priority to the national biofuel policy, so successfully implemented by his predecessor.

Indeed, there are hardly any government officials at present in the ministries, which were once considered as supporters of biodiesel (Mines and Energy, Agriculture and Rural Development, and Environment, Housing and Territorial Development) who really master the subject of biodiesel and are fully aware of its strategic significance for the country. No one is left in the administration from that team that devoted time and effort to the development of biodiesel; hence the great difficulty in having positive communication between the private and the public sector.

Consequently, a new task for the oil palm growers who have become biodiesel producers is to build trust, educate and train the members of the Government on

the benefits of their fuel, while the latter develop an interest regarding this scantily explored universe, perhaps through their participation in the various settings opening up in the world for this purpose.

Should that not happen, they could make mistakes that would end a program that has met the purpose for which it was planned, like for example, the passing of Decree 4892 of December 23, 2011.

As if that were not enough, the Government has already announced its intention to revise the price policy, leaving in the air a feeling that there is no such thing as legal stability for the national biofuel policy on which once both the public and the private sectors worked together. The policy finds itself today in a no man's land, neglected by a State which does not see it as an option for rural development, not even in those regions where the Government has agreed to return the land to the internally displaced population and the victims of violence, using sustainable production projects.

Photography: Courtesy of Bio D.S.A.

Bio D S.A. Biodiesel plant
Location: Facatativá, Cundinamarca. Capacity: 115,000 t/year. Inauguration: February 2009

Chapter 3

Oil Palm biodiesel, energizing Colombia. Photography: Toro, F. (2009).

Oil palm becomes an energy business

For us, trust is a means for investment,
investment is a tool for growth, and
growth offers the possibility of overcoming
poverty and building equality.
Álvaro Uribe Vélez

In the early 90s, while the biofuel market in Europe was re-energized, Colombia was going through a time of great social and economic turbulence. This was mainly because of the globalization that loomed in the horizon for domestic production which had been protected for many years under the import substitution model, but was now open to international competition.

As a result of lower tariffs and a modernized foreign exchange system, the price of imported goods began to drop, supplanting local goods, regardless of whether imported goods were of industrial or farming origin. So much so that, during this decade, the agricultural sector performed perhaps the worst it had ever done because planted areas dropped by almost one million hectares under the pressure of subsidized and protected foods and raw materials coming from other countries. This was compounded by a significant technological lag in the sector as well as the revaluation of the Colombian peso – fueled by higher foreign debt and public spending. Eventually, all these factors accelerated the loss of the sector's competitiveness, both in domestic and international markets.

Essentially, it was temporary crops that accounted for the strong reduction in the farming area, in contrast with perennial crops that grew by close to 300,000 tons. Oil palm, in particular, grew at a rate of 8.5%,[1] increasing its share in the value of agricultural production from 1.1% in 1995 to 2.5% five years later.

Yields were such that total palm oil production in 1998 amounted to 410,000 tons, while domestic demand amounted only to 320,000 tons. Two years later,

1 Fruit crops grew 10%, sugar cane 4%, flowers 4.3%, and bananas 2.9%.

by the end of the decade, surpluses were exported (125,000 tons). Despite low competitiveness overall, the sector, headed by Fedepalma, managed to position Colombia as the top oil palm producer in Latin America and fourth in the world.[2]

This was made possible by Fedepalma's bold action, which found the way of creating openings for the sector in external market niches, making sure at the same time that crop yields improved. The means were C.I. Acepalma, created in 1991 with the mission of leading the direct marketing of palm oil in the international markets; and Cenipalma,[3] which from the very first day has been developing specific technologies for the different regions[4] in an effort to ensure sustainability for the agribusiness.

Despite positive action from the business community, oil palm growing did not escape the effects of the wave of violence still present in Colombia, with its significant repercussions on development. Farmers in general had to flee from their land as a result of extortion and indiscriminate kidnappings, while coca plantations bloomed throughout the Colombian territory, protected by guerrillas or paramilitaries. Paid by the drug lords, they intimidated the workers and evicted them from their land, as was the case in Tumaco in the south, as well as in many other regions of the country where armed dispossession has been the law.

The agricultural situation did not escape the national political reality. In 1991, Colombia wrote a new Constitution that replaced the old one of 1886, and did so in the midst of rampant narco-terrorism, public unrest, and a weakened and fearful justice system.

As if that were not enough, by the mid-90s the internal conflict had intensified in the middle of the governing crisis of the Samper administration: President Ernesto Samper Pizano had been charged with a relationship between his election campaign and the illegal drug business. All these factors eventually merged in

2 In the late 1990s, the main palm oil producers in the world were Malaysia with 11 million tons, Indonesia with 7 million, Nigeria with 740,000, Thailand with 560,000 and Colombia with 524,000 tons.

3 Oil Palm Research Center Corporation, created by Fedepalma in 1991.

4 The Oil Palm Growers Federation of Colombia has divided the country into four large oil palm growing regions: Southwest, comprising the municipalities of Tumaco (Nariño), Belen de los Andaquies (Caqueta), and Guapi (Cauca); East, comprising the Departments of Meta and Casanare, plus the municipality of Paratebueno (Cundinamarca); North, comprising the Departments of Atlantico, Bolivar, and municipalities located in Antioquia, Cesar, Choco, Cordoba, La Guajira, Magdalena and Sucre; and the Central region, comprising municipalities located in Antioquia, Bolivar, Cesar, Cundinamarca, Santander and Norte de Santander.

1999, during the Pastrana administration, to produce not only a profound economic crisis but also a social crisis of a population living under the threat of violence, in hopelessness and cynical of its governors.

At that time, therefore, the competitiveness of the sector suffered another setback caused by the insecurity and the so-called country risk. This aggravated the already high costs associated with the uncompetitive exchange rates, and issues of logistics and sales due to the inadequate transportation and road infrastructure.

Added to this were the elevated production costs of the agricultural sector in general. Despite high-yield crops like oil palm (close to 4 tons per hectare at the end of the twentieth century) costs were extremely high when compared with other countries like Malaysia and Indonesia.

Consequently, by the end of 1999, conditions for exporting surpluses mainly to Europe – accounting for 20% of the production of 500,000 tons of palm oil at the time – were sadly uncompetitive. Furthermore, had there not been critical instruments in place for stabilizing prices, for optimizing income for producers, and for marketing the palm oil,[5] the transition from a protectionist to a neoliberal model would have been disruptive, if not chaotic, for the oil palm sector.

Following the failed peace talks with the subversive groups undertaken by his predecessor, the Uribe administration, building on its policy based on democratic security, the respect for freedom and the search for social cohesion, trust, and respect for State institutions, took control of territories previously in the hands of the subversive groups. Together with economic measures, this paved the way for the reactivation of the Colombian economy.

5 Such as the Andean Price Band System (SAFP, for its acronym in Spanish) and the Price Stabilization Fund for Palm Kernel, Palm Oil and its Fractions (FEP Palmero, for its acronym in Spanish).


7

In the late 1990s, the palm agribusiness counted on palm oil surpluses which were directed to the export markets. Photography: Toro, F. (2009).

The market in the 1990s

One of the first agrarian policy measures adopted by the Samper Administration[6] to re-energize farming after the upheaval caused by the aperture was harvest absorption. Growers and industrial producers were urged to reach agreements to ensure that the latter would absorb all the production of the former. In exchange, the Government allowed them certain import quotas for other oleaginous inputs.

For the oil palm sector, this was not enough, because growers were forced to commit to exporting, given their surplus production. Although the agreement worked, it was far from perfect. The final blow came from the inside, when some growers, in fear of their increasing surpluses, stopped contributing to exports with the argument that prices were much lower than those of the domestic market. They started selling to producers who had not been part of the agreement to absorb the local crops. Although the price they obtained was lower than they could obtain from the industries that were party to the agreement, it was still higher than what they could garner on the international market.

Fortunately, although the crop absorption agreements failed, Fedepalma, with the support of Fecolgrasas, succeeded in its lobby to create the Price Stabilization Fund for Palm Kernel Oil, Palm Oil and its Fractions (FEP Palmero, for its acronym in Spanish), supported by Law 101 of 1993. The idea was that the Fund should operate on the basis of grants and compensation mechanisms that would balance income for the sector and facilitate the organized sale of palm oils in markets with price differences.

Although stabilization funds created by Law are instruments designed to strengthen the marketing of a product against price volatility in various markets, some producers again tried to block their implementation believing that they were a new form of taxation that would play against them. This meant that the implementation of the tool was delayed.[7]

In practice, the effect of the FEP Palmero is to eliminate differences between domestic or foreign sales of palm oil because producers receive compensation if they sell in a lower price market, and they must pay a grant if they sell in a higher price market. With the introduction of this mechanism came the end of the absorption agreement between growers and industrial producers of edible fats and oils.

6 Ernesto Samper Pizano, Colombian President, 1994-1998.

7 The FEP Palmero was legally organized in December 1996 and began to operate in 1998.

So this is how things stood when, in February 1999, six of the main companies working in the oils and fats business[8] created a group called TEAM in order to identify strategies for the domestic and international development of the business, creating synergies with the aim, among other things, of lowering their costs.

One of the first actions of TEAM Chairman Mauricio Campillo was to attack the FEP Palmero precisely because he realized that it allowed oil palm growers to strike deals with industrial producers using the import cost option instead of the export FOB. But producers, already aware of the benefits offered by the FEP, went head over heels to defend it, and succeeded, which reinforced their appreciation for the mechanism.

To grow or not to grow, that is the question

Precisely around that time, Colombia's energy future was a source of concern, given that oil reserves were being depleted rapidly, suggesting that by 2010 the country would become a net crude oil importer. Dependence on third parties would jeopardize its energy safety. A process of "dieselization" of the motorized industry was also under way, which meant that diesel, because of its lower price, would soon oust gasoline from its preeminent position.

In such a scenario, President Uribe foresaw an opportunity to develop the biofuel industry, with the idea not only of diversifying the energy mix but also of ensuring national self-sufficiency through this source. This was at a time of strong world pressure due to the shortage of oil and the search for new environmentally friendly alternatives. He also saw an opportunity to give new momentum to agricultural activities, create rural jobs, and achieve socioeconomic stability in the rural areas.

Unlike his predecessor, who refused to sign the alcohol fuel law on the grounds that it was unfavorable for the nation, President Uribe confirmed his conviction about the benefits that renewable fuels would bring to his development plan, and this he stated from the very beginning in his addresses to his fellow citizens.

8 The members of this partnership are Acegrasas, Fagrave and Gravetal, specialized in the processing of vegetable products for the production of liquid oils, table and cooking margarines. The other two companies are Grasyplast and Grandinos, which although they are not fat producers, have interests in the sector, the former manufactures packaging for the industry, and the latter markets its products in the Andean market.

The agricultural sector became a priority during the two terms of the Uribe Administration. Through the combination of security, social and economic measures, the sector grew at an average rate of 3% per annum. In 2009, the planted area amounted to 4.9 million hectares, of which 1.6 were covered with short-cycle crops, 2.9 with late and long yields crops, and 352,000 with forestry plantations.

The 21st century looked even gloomier in terms of placement of palm oil surpluses. In fact, difficulties increased during the first few years, since production outpaced the growth of the domestic market, leading to an increase in exports at a rate of 18.8% between 2000 and 2004, from 100,000 to 215,000 tons.

The situation became even more dramatic when, around that time, the average international price per ton of oil palm was set at 290 dollars and the local average production costs surpassed 350 dollars, much greater than those of Malaysia (249) and Indonesia (172). Obviously, this represented a sacrifice in the profit margins of the oil palm sector.

Such was the oil palm scenario when President Álvaro Uribe Vélez began urging growers to increase planting as an important source of well-paid employment. Larger areas planted with a perennial crop would bring social stability to the rural areas, and oil palm could potentially become an energy crop that would position Colombia as a significant participant in the world biofuel market.

In fact, the crop had been growing since the beginning of the decade, basically because of the implementation of a new sectorial development model called "productive alliances"[9] which was an Federation between large companies and smallholders. The growth had been so much that, between 2002 and 2006, the planted area increased from 185,000 to 292,000 hectares, of which only 60% was in production.

This led oil palm growers like César de Hart Vengoechea, President of Fedepalma's Board of Directors, to warn about how unwise it would be to increase the numbers of plantations destined for biofuels on the basis of a crop that was still lagging behind its international competitors.

De Hart believed that it was very risky to burden the sector with the responsibility of acting as the social engine in the rural area, following in the steps of Malaysia. This given the fact that Malaysia is a truly competitive country in oil palm that has the luxury of waiving productivity in exchange for social wellbeing, thanks to

9 For more information on this strategic alliance project, see Chapter 6.

The Government promoted increase in planting as a policy for social stability in rural Colombia. Photography: Toro,F (2009).

clear and long-standing government rules. In a few words, de Hart considered that development of agriculture in Colombia should not depend on the good intentions of the current administration, and that a government push to expand planted areas could only result in disaster for the development of the oil palm sector.

Consequently, de Hart resigned as Fedepalma's Board of Directors President at the end of 2004. He did not agree with the way sectorial policy was being managed by the Federation, in the sense of not doing more to prevent the rapid growth of the planted area before first securing competitiveness.

The unity of the chain is broken

Around that time, a divide was created between the agricultural and the industrial links of the chain, in the midst of the negotiations for the free trade agreement (FTA) with the United States. The growers did not yield to the demands of the industrial producers for eliminating the safeguards which they enjoyed at the time, namely, the price bands and the FEP Palmero.

This new disagreement added to the tug-of-war generated at the time of the crop absorption agreement, undermined the relationship between industrial producers and palm growers. The situation worsened when Colombia, as a member of the

Andean Community of Nations (CAN) began negotiations for a free trade agreement (FTA) with Mercosur,[10] eventually adopted in 2004.

Some edible oil producers, under the leadership of the President of the Alliance TEAM, expected the Government to eliminate all import duties on crude oils coming from the member countries, from the very moment the agreement entered into force. At the same time, they wanted duties on refined oils – i.e. their own products – to be phased out slowly, over a 15-year period.

The member nations of Mercosur are big producers in the world market for soybean oil, a substitute for palm oil. Consequently, the idea of reducing import tariffs down to zero would have meant a disaster for the domestic oil palm sector. The whole situation created new tensions between oil palm growers and industrial producers of oils and fats. However, the last straw that broke the camel's back came during the negotiations of the FTA with the United States. This time, the upset from the TEAM group came in the form of a similar demand: to remove all import duties on their raw materials (crude oils) but maintain duties on their refined products. The palm growers countered by demanding equal treatment for all, using a good Colombian phrase: "Either all in the bed, or all on the floor". They meant to say that zero duties should apply both to crude and refined oils from the first day of enforcement of the agreement.

Although unwillingly, the two parties had to sit down, at the request of the government, to reach an agreement that would enable them, as an industrial chain, to show a strong position in front of the North American negotiators. However, no agreement was reached and the unity of the entire chain was ultimately destroyed because, although the Government did not yield to the pressures of the powerful TEAM conglomerate and upheld equitable rules for both parties in both treaties, it did implement the gradual elimination of duties for all of their products.

The situation described above had been traditional between the oil palm growers and the industrial edible oil producers. However, it should not be ignored that each one of them also had their own internal struggles. In 2005, after the completion of the negotiations of the FTA with the United States, the industrial producers of edible oils decided to close down their association (Fecolgrasas) due to strategic differences between their associates.

10 The Southern Common Market (Mercosur) is a trade block created in 1991 by Argentina, Paraguay and Uruguay.

Oleo-chemicals: the sector's bet

The commercial problems had their own urgency in each one of the oil palm growing areas, particularly the Eastern region, which was clearly at a disadvantage when it came to positioning its oil in foreign markets, mainly due to the high shipping costs of taking its product to the ports. The Central region was mostly united with the industrial producers of oils and fats, and although this market did not absorb all the products, it alleviated the pressure a little during peak production. The Northern and Southwestern regions, because of their location near the ports, had a competitive advantage for exporting.

However, all the regions shared the urgent need for finding and developing new market sectors. This led the Oil Palm Growers Federation to focus on the development of marketing strategies.

In fact, it has always been known that palm oil serves countless industries. Malaysians are true "geniuses" when it comes to its use in oleochemistry for the production of cosmetics, cleaning products, candles, printing inks, lubricant acids for the textile industry and a host of other applications that no unsuspecting buyer could imagine. Therefore, oleo-chemicals may very well compete with petrochemicals and beat them when it comes to the preferences of the modern day consumers, given the serious environmental damage associated with the petrochemicals.

But Colombian oil palm growers had been shy in treading this path. Perhaps because they were not competitive; perhaps because they did not want to risk attaching value to their raw material before they secured a market; perhaps because they knew that, in Colombia, exporting is a very expensive enterprise and internal demand is insufficient; perhaps because of the high cost of the country risk; perhaps because of the need for economies of scale…

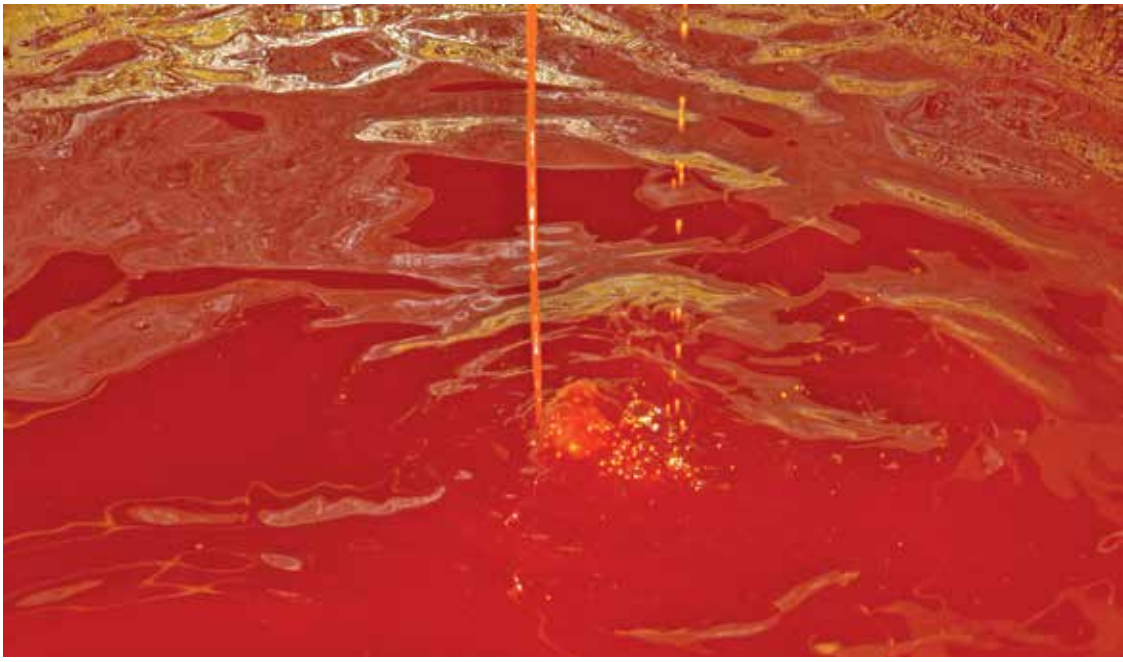
Before turning their eyes on oleo-chemicals, they had considered the traditional food industry. The growers of the Eastern region had been studying different options to sell their palm oil on the domestic market. That way they would not have to pay the exceedingly high freight costs of taking their product to a Colombian port, much higher sometimes than the cost of shipping the oil to Europe.

A case in point is the frustration of Mauricio Acuña Aguirre, general manager of Entrepalmas S.A. In the early 2000s, he purchased some shares in Fanagra (Fábrica Nacional de Grasas) in exchange for palm oil and financial resources for its growth. However, the deal was not successful and ended in the splitting of the

company in two. The kernel oil production plant went to the palm growers and the rest of the company remained in the hands of the old partners.

The Eastern region growers realized then that their sustainability could not continue to depend on a traditional food market unable to absorb their supply, or on an export market subsidized by the large oil producers. Consequently, in 2002, a group of companies from the region decided to come together in order to develop an oleochemistry project focused on the production of biodegradable soaps. The members of the group were Entrepalmas S.A., Hacienda La Cabaña S.A., Guaicaramo S.A., Unipalma S.A. and Palmeras Santana S.A. Its leader, Mauricio Acuña Aguirre, prompted by his previous disappointment, had vowed to himself never to become involved in the food business again.

For his part, Carlos Murgas Guerrero, an important oil palm grower, had learned during his travels in Malaysia about the potential of oil palm for biofuel, and was the first person to share the idea about this new product with his colleagues. When the idea did not resonate, he decided to start on his own, and a few years later he was pioneering biodiesel production in Colombia.



Oil palm growers looked for new alternatives in oleo-chemicals to absorb their surpluses.
Photography: Toro, F (2008).

At the same time, in answer to the mandate of its Board of Directors, Fedepalma was making progress with the creation of its Marketing Management and Market Promotion sectors and the organization of a marketing workshop to be held late in 2002. This exercise included the commercial experiences of a significant group of growers[11], and defined a new strategy to tackle the issue. As a result of the workshop, new markets were explored, including oleo-chemicals in general and biodiesel in particular.

In relation to the former, a study conducted under the leadership of Fedepalma and Cenipalma concluded that the market was quite small in Colombia and would not absorb the expected surpluses.

Regarding biodiesel, the Federation did not only make great strides in the study of the international state of the art, but also learned that the academia had its own studies. Consequently it invited professors John Agudelo from Universidad de Antioquia and Lesmes Corredor from Universidad del Norte to share their findings. In the forum, the researchers emphasized the great opportunity Colombian growers had for converting their palm oil into methyl ester (biodiesel) and replacing highly contaminating diesel (fossil fuel) with a more environmentally friendly fuel.[12]

The findings presented by the academics, as well as the hype about biofuels in the world, and the momentum created by the Colombian Government, all contributed to galvanize the interest of Fedepalma's Executive President, Jens Mesa Dishington, into conducting an in-depth analysis of the real potential of biofuel and its possibilities in Colombia, where knowledge was meager.

Around that time, Arturo Infante Villarreal had returned from Malaysia where he had served as ambassador[13] and had had first-hand experience of the oil palm sector and the oleo-chemical industry in that country, and in particular with the use of biodiesel as fuel in the transportation system.

Fedepalma hired him, together with chemical engineer Eduardo Del Hierro, to prepare a study about the technical and economic pre-feasibility of producing oil

11 Board members of Fedepalma, C.I. Acepalma S.A., and Cenipalma as well as members of the Committee for Parafiscal Funds and Fedepalma's leaders.

12 According to the academics, the content of sulfur in the diesel fuel used at the time in Bogota was more than 1,000 parts per million (ppm), and greater than 6,000 ppm in the rest of the country.

13 Arturo Infante Villarreal, Colombian ambassador to Malaysia, Thailand and Vietnam between 1996 and 2002.

palm by-products for use as fuels for diesel engines in Colombia. The aim of the study was to provide Fedepalma with conceptual elements to support its actions for the following years.

A few months before, during the International Oil Palm Conference, James Fry[14] had delivered a lecture on biodiesel, with the goal of creating awareness among oil palm growers and setting the stage for the development of a market unknown to the sector until that moment, and which could become the solution for the sale of Colombian palm oil in the near future.

In August 2004, the results of the study conducted by Infante and Del Hierro shed light on the real possibilities of building a business on palm biodiesel. Indeed, the study concluded that with the price combination of 35 dollars per barrel of petroleum[15] and 450 dollars per ton of palm oil, it made practically no difference to the consumers whether they used diesel or palm biodiesel in their diesel engines. It also concluded that the industry would have possibilities of receiving emission reduction certificates if it used biofuel over fossil fuels, as long as its use was voluntary and not compulsory.

Looking and learning outside

Some months later, Fedepalma saw the need for growers to examine the results of the study in greater depth. Consequently, it organized a mission to Malaysia late in 2004, and a visit the United States in February 2005. Both missions, jokingly characterized as *bio tourism*, were crucial for the definition of the biodiesel business in which they were about to become involved.

The mission to Southeast Asia was a crucial opportunity to build synergies and close gaps between those who had been working on the topic in a dispersed way. The mission included academics, government officials, as well as representatives of the Colombian Oil Institute (ICP) and of the oil palm sector. Although Malaysia at the time did not have an industrialized operation, everybody confirmed that palm biodiesel was indeed feasible.

The aim of the mission to the United States was to attend the annual conference of the National Biodiesel Board (NBB). This time, the Minister of Mines and

14 From LMC International, an English company specializing in economic and business consulting for the agribusiness sector, with longstanding world experience in the area of oils and fats.

15 A ton is equal to 7.3 barrels of oil.

Energy, Luis Ernesto Mejía Vélez, joined the group and was able to see, first hand, the technical and economic viability of biofuels in the world.

The Corredor Mejía brothers, Carlos and Jorge, whose plantations were in the Southwestern region, took advantage of the Minister's enthusiasm and summoned their colleagues to a meeting to discuss the issue of costs. They believed that the existing cost structure would curtail the competitiveness of Colombian palm biodiesel in the market. The discussion would also include the importance of tying the price to the raw material and not to petroleum because, as they had heard from the speakers at the NBB meeting, renewable fuel is not comparable to fossil fuel in cost terms because it is much more expensive to produce. That explains why all countries where biofuels are used offer incentives to promote their production and use.

With his attitude, the Minister helped oil palm growers realize that the government's willingness to develop palm biodiesel as a country project was indeed real. In fact, he informed them of the creation, a few months before, of the National Biofuel Board (NBB), led at the time by the Ministry of Mines and Energy and, in particular by its Hydrocarbons director, Julio César Vera Díaz.

Fedepalma proceeded immediately to play an active role in the working group through its technical team led by Alejandra Rueda Zárate, Marketing and Market Promotion director, and Mónica Cuéllar Sánchez, Cenipalma director of Alternative Applications. The team worked on the development of the building blocks for the technical, logistic, environmental, economic and legal definitions of the project.

The next four NBB conferences provided essential insight into the state of the art of biodiesel in the world. The presentations from international experts, as well as the studies discussed were used not only as the starting point for the definition of a large number of technical, economic and marketing concepts for the biodiesel program in Colombia, but also to build one of the most comprehensive libraries on the topic in the form of the Oil Palm Information and Documentation Center.

Fedepalma did not focus just on the technical aspects before making the decision to enter the energy world. It also conducted social and environmental analyses, which enabled it to identify the widespread need for greater advancement and wellbeing in the rural areas. By 2001, 55% of the workers in the developing countries worked in farming, and 70% of the poor lived in marginal areas and derived their sustenance from agricultural activities.

Another finding was that global oils and fats production was only 3% of that of diesel. Consequently, biodiesel could become one of the solutions for partial substitution. Likewise, the world biofuel market needs to be supported by public policy, because alternative energies alone, until now, have not been competitive in relation to fossil fuel.

The action begins

The year 2005 was doubtless very intense in terms of the joint work of oil palm growers, government officials and academics. Mauricio Acuña Aguirre had only recently taken office as the President of Fedepalma's Board of Directors after César de Hart Vengoechea, when early in the year he met with Álvaro Uribe Vélez, together with other colleagues and the Executive President of the Federation. From the start, the head of state warned them that if they had come to "plead", they were in the wrong place.

Not without a little fear, the growers expressed their concern about the fact that the Government was promoting new planting in order to use the palm oil for the production of biodiesel, but they felt that at the same time they were not given a clear plan for the future. It was their belief that this could result in dire economic and social consequences.

Some days later, the same growers called on Carlos Gustavo Cano Sanz, Minister of Agriculture and Rural Development, who was preparing to leave office in order to take a seat on the Governing Board of the Republic Bank. Coincidentally, they witnessed how he received a fax from President Uribe with documents and information about biodiesel, together with instructions to read and circulate them in order to advance in the theme.

The Minister's prompt action reinforced the perception among the growers that the Government was indeed intent on prioritizing the use of biodiesel as a means to reenergize farming activities, expand the energy mix for the country, and improve the environment, among other social and economic reasons.

Fedepalma sought opportunities with all individuals or organizations that could help structure the biodiesel industry; its members were eager to be part of the national development. After all, they were used to doing precisely that: offering new options to improve the quality of life, the working conditions and the well-being of the communities that surround the oil palm, which today is sown in 108 municipalities of 17 departments in Colombia.

They even sought discussions with Ecopetrol S.A. in order to understand the workings of the fuel business. The state-owned oil company was now more than willing to participate in the biofuel market – unlike with ethanol – driven by factors that ranged from improved fuels to preserving their market leadership. After the first meeting, Fedepalma and Ecopetrol S.A. agreed to exchange information to ensure the rapid advance of the project.

Fedepalma also joined Fedebiocombustibles,[16] an organization led by Jorge Cárdenas Gutiérrez and Jorge Bendeck Olivella, who considered energy agriculture as a great opportunity for rural and regional development.

Also in mid-2005, the Colombian-German Chamber promoted a mission to Europe with the aim of learning about the various technologies for biodiesel production. With the logistic support of Fedepalma, an interdisciplinary group consisting of representatives from the private sector, the government and academia, toured different production plants in order to gain knowledge about technologies developed mainly in Europe.

One year later, the same Chamber again asked Fedepalma to support German visitors who wished to travel 27,000 kilometers from Tierra del Fuego to Alaska using 11,000 liters of biodiesel. They would travel the entire Pan-American Highway on this renewable fuel, which was hardly known in America. The mission was on the road for 15 days and accomplished its purpose of showing the benefits of biofuel to the world.[17] On May 14, 2006, the travelers traversed Colombia from Cartagena to Pasto in 43 hours, before continuing on to Ecuador.

Where to put Fedepalma's money?

Around that time, breaking the paradigm of the type of research it conducts, Cenipalma joined efforts with Ecopetrol S.A. and the ICP in order to characterize oil palm biodiesel[18] and develop pilot and dynamometric engine testing.

There were heated internal discussions in Cenipalma and Fedepalma about the allocation of the scarce research funds at a time when bud rot disease (known in Spanish as PC) was ravaging large planted areas, especially in Tumaco. The

16 National Biofuels Federation (Fedebiocombustibles) gathers biodiesel producers, ethanol producers, sugar and oil palm producers, among others.

17 For more information, go to www.panamericana2006.com

18 Palm biodiesel was produced by Interquim, an Antioquia-based company, the only one producing it at the time in a pilot plant.

members of the Board of Directors were divided: those who were in favor of gaining in-depth knowledge about biofuel argued that downstream investment was the right thing to do if palm oil was to remain on the market; those who were against thought that the whole thing was just another fashionable "little project" with scant opportunity to succeed and an uncertain future.

Finally – and happily as was said in retrospect – the expectations about future sales prevailed over the sanitary realities of the crop, and a part of the Oil Palm Growers Federation fund was wisely allocated to studies on palm biodiesel. In any case, financial resources earmarked for that purpose grew in 2007: the government had accepted Fedepalma's proposal of a 1-1.5% increase in the oil palm development fund fees paid by the growers to fuel research.

Efforts were not in vain. Indeed, it was demonstrated that oil palm could be recognized as an energy crop with great potential and that the characteristics of the oil as raw material for biodiesel were better, by far, than those of other energy crops with lower yields per hectare and a lower energy balance.

In fact, the Cenipalma-Ecopetrol S.A. study had very interesting and positive results, including the finding that even blends of 30% biodiesel with 70% diesel retain the properties of the fossil fuel, or that the particulate matter when only biodiesel is used (B100) is 53% less when compared with regular diesel, and 17% lower when compared to premium diesel.[19] The study also showed that, unlike biodiesel derived from other raw materials, palm biodiesel reduces NOx emissions by almost 20% when compared with fossil diesel.

This was confirmed by Mauricio Rojas in his thesis sponsored by Fedepalma for Chalmers University of Technology in Sweden, according to which the better ignition characteristics of palm methyl ester results in lower NOx and HC emissions.[20]

But if the internal debates were heated regarding the decision whether or not to conduct research on a product that was still largely unknown in the world with the goal of entering a business that had been exclusively in the hands of the oil tycoons, more heated still were the debates with biodiesel opponents outside the oil palm growers' Federation orbit.

Particularly difficult were the people who had no knowledge whatsoever of the palm oil market in the country, and grounded their arguments on the perils to food safety.

19 Results of the Ecopetrol S.A.-Cenipalma Project, 2006.
20 Rojas, M. 2006

They did not recognize that biodiesel production was proposed on the basis of using the surpluses that had never been absorbed by the local traditional food industry.

Some non-government organizations (NGOs) were also reluctant. Without stating their arguments, they insisted on extrapolating to Colombia the kind of damage to the environment and the wild life caused by oil palm crops in Malaysia and Indonesia. Their belief was that, in those countries, palm oil was established at the expense of large areas of forest, depriving endangered species like the Sumatran tiger and orangutans of their natural habitat.

Paving the road to renewable energy

Initially, the Oil Palm Growers Federation's idea was that, regardless of whether regional biodiesel plants were set up, a national unit would be developed under the coordination of Propalma S.A., for the production of 300,000 tons of biodiesel in three plants. Although the production project would be a commercial operation, it would work under the philosophy of the Federation in order to ensure that all palm growers would have a share in the production plant and the right to sell the oil.

This idea was the focus of intense controversies within the sector, originating in particular in the oil mills integrated with the edible oils and fats industry, which were reluctant to join the business. Another element that fueled the discussion was Fedepalma's past experience with similar commercial initiatives such as the successful C.I. Acepalma, and the failing Propalma. This also contributed to reservations regarding the model.

Fedepalma promoted, through Propalma, the contraction of an investment banking company to study the financial and legal feasibility of a biodiesel project.

The results of the study revealed that the investment required to set up the biodiesel plant amounted to one sixth of the cost of establishing the crop that was required to produce the oil needed to feed it. This destroyed the notion that entering the playing field of the giant producers of fuel was an exceedingly costly endeavor. On the contrary, the study made it clear that the investment in crops was already done, and this reinforced the idea that it was the oil palm growers who should develop the business. In other words, while biodiesel producers in the world were facing the latent risk of not having access to raw materials, that risk in Colombia was totally allayed.

The idea of a national project for biodiesel production was thwarted by the complexity resulting from the cultural diversity of the oil palm-growing regions when

it came to managing a single business; the pressures from a few growers who did not want Fedepalma to lead it, with the argument that such leadership was contrary to free business development; and the fact that there were already some individual initiatives under way. So Fedepalma stepped aside, but it did not refrain from proposing to its members the option of creating regional associative groups of producers. The report from the external consultants became then the seed for the emergence of various individual and associative initiatives that opened, tentatively, the national production map to a little more than 500,000 tons of biodiesel per year, as follows:

Three projects in the Northern region, encompassing the production plants of Oleoflores S.A., Biocombustibles Sostenibles del Caribe (resulting from the alliance between Grupo Daabon and Palmeras de la Costa), and C.I. Biocosta, representing seven mills[21].

At the time, there was no clear interest in the Central region for developing biodiesel projects, considering that it was the region with the highest degree of downstream integration with the food industry.

Three projects were on the horizon in the Eastern region: Manuelita S.A. had already entered the ethanol market with its sugar mill in Valle del Cauca, and it was doing the same with its oil palm plantations in the Eastern Plains. The second was the Bio D S.A. project, which not only gathered the first growers in the region that showed interest in developing an oleo-chemicals project, but ended up including oil palm growers from the Southwestern region[22] as well as other fruit producers. Finally, the Biocastilla project was the third one.

In the Southwest Zone, Palmeiras and Palmas Santafe were leaders in promoting the business in the region through Biodecol, a company established for that purpose. For Tumaco, with its proximity to the port, the project was truly strategic because of the opportunity to import oils from Ecuador to reinforce biodiesel production, and also to produce renewable fuel for export[23].

21 Aceites S.A., C.I. El Roble S.A., Extractora Frupalma S.A., Palmaceite S.A., Palmagro S.A., Extractora Ariguaní S.A., and Palmas de Casacará.

22 Astorga S.A., a mill owned by the Varela family, partnered with the oil palm growers in the Eastern Region because they believed the conditions in Tumaco were not appropriate for investing in biodiesel.

23 By then, some plantations were already showing evidence of bud rot; however, it was not expected that the disease would be lethal and it was thought that the plants would recover as had happened in the Eastern Plains; however, this did not turn out to be the case.

Business leaders or managers interested in the production of biodiesel began to work hand in hand with the Federation in the development of the technical, commercial, economic and legal regulations, and to take an active part in the National Biofuel Board. Names like Mauricio Acuña Aguirre, Carlos Murgas Guerrero, Luis Fernando Herrera, Juan Miguel Jaramillo, Rodrigo Belalcázar Hernández, Tito Eduardo Salcedo Díaz, Carlos Corredor Mejía, Armando José Daza Daza, Luis Francisco Dangond and Alfonso Dávila Abondano were among those pioneers who worked closely with Fedepalma's Executive President Jens Mesa Dishington and his technical team, and with Jairo Cendales Vargas, manager of Propalma. As promoter of oil palm projects, the latter had been entrusted with supporting the development of this plan.

While all this happened, Fedepalma and Cenipalma continued trying to obtain a technical quality standard, a sign from the government regarding prices for the purchase of biodiesel, and an assurance regarding the purchase of a minimum volume of the renewable fuel. They were also making progress in research, and developed, together with Ecopetrol S.A. and SI99 – one of the Transmilenio operators – a long-term test using palm biodiesel in the articulated buses of the mass transportation system in Bogota. The test was of pivotal importance to the credibility of the program, considering that the excellent results obtained set the basis for determining the different blend levels that could be used in the country (up to B50), as well as for defining the regulations required for the adequate management of biodiesel throughout the supply chain.

The public sector did not fall behind and was making rapid progress in the development of the regulations. Thus, by October 2006, the country received an interim technical standard for biodiesel production.

The Executive branch, led by the President and his ministers of Mines and Energy,[24] and Agriculture and Rural Development,[25] was aligned with biofuel development and the social wellbeing that it would bring, and did not miss any opportunity to promote the three pillars of the program: self-sufficiency and diversification of the energy mix; environmental improvement; and development of the agricultural sector with the resulting creation of rural employment.

It was during the 2006 annual congress in Villavicencio, that oil palm growers finally made the decision of moving forward to build biodiesel production plants.

24 First Luis Ernesto Mejía (2002-2006) and then Hernán Martínez (2006-2010).
25 First Carlos Gustavo Cano (2002-February 2005) and then Andrés Felipe Arias (2005-February 2009).

This came about as a result of the trust created by President Uribe when he replied to a question about the free zones:

> The answer is easy: start building your biodiesel plants now and be assured about the benefits. But start doing it now. My four years will fly by and we need to move quickly.

Only a few months later, a series of public policies took shape, sending clear messages to the internal investors in palm biodiesel in Colombia.[26]

Thus started the process of selecting and acquiring the technology that would best fit their needs. It is worth noting that the average cost of a 100,000-tons plant ranged between 21 and 27 million dollars. The Tumaco growers abstained from participating because their crops had bud rot disease, even though Ecopetrol S.A. had assured them of its support in the biodiesel project. In fact, one year later, the disease devastated 30,000 oil palm hectares, thwarting the promise of economic and social development that the crop held for the region.

Another project that did not see the light was that of C.I. Biocosta S.A., because the financial studies did not convince the group about the long-term sustainability of biodiesel. The lead voice was that of Armando Daza, chairman at the time of the Propalma board of directors and general manager of Aceites S.A. He was skeptical about the project and told his colleagues that an investment of 20 to 30 million dollars in a business supported by incentives and the good will of a government would take a long time to pay off and that they should better postpone the decision and watch how the market evolved. However, they should remain united in the meantime.

That was the decision of the oil palm group,[27] and although its name suggests a biodiesel business, it ended up doing something radically different from what had brought it together to start with: it focused on placing its product on the domestic and the external markets, contributing to an improved marketing activity for the sector. C.I. Biocosta became a conglomerate of six palm oil producing and milling companies with a production capacity greater than 130,000 tons, accounting for 15% of the total domestic production.

26 For example, Decree 2629; resolutions 182142 and 182087, and Decree 4051 regarding permanent free zones for agribusiness projects. For more information, see Chapter 2 of this book.

27 Except for Palmas de Casacará, which maintained the idea of setting up a biodiesel plant that has not materialized to this date.

Never before in Colombia had there been a supply source of palm oil such as the one created by the people from the coast. And how well they have done, especially at a time when the bud rot disease destroyed thousands of hectares in Tumaco, jeopardizing the supply of palm oil.

However, even before the business took shape, the growers from the coast and from the Middle Magdalena (mainly from Santander and Cesar), given the proximity of their agribusiness, had been sending signals to each other in an attempt to join efforts for the construction of a biodiesel plant. After all, a traditional leader like César de Hart Vengoechea, with the "two bloods in his veins", could be the key piece in bridging the gap between the two regional idiosyncrasies.

Once at the negotiations table, cultural differences prevailed over their best desires, and nothing was accomplished. The producers from Santander wanted a majority share in the company and those from the coast would not yield. At the same time, Ecopetrol S.A. was looking for partners among oil palm growers to participate in biodiesel production, and the growers from Santander were very willing to lend an ear to other proposals. After all, they were the local players in Barrancabermeja, home to the state-owned oil refinery.

Steadfast players

Without a hint of a doubt, it can be said that the boldest of all the growers in Fedepalma is Carlos Murgas Guerrero. Boldness is in his DNA and it showed in the way he approached the biodiesel undertaking.

He had been gathering information for several years and had spoken to his colleagues on the Board of Directors about the way biodiesel plants operated in certain countries in Southeast Asia and Europe, but it was one of those sudden impulses that characterize him, which made him jump into the water and invest a huge sum of money.

Together with other oil palm growers and government officials, he went on a visit to a European company during a mission organized by Fedepalma in 2004 in order to gain knowledge on equipment operation. After the tour and the routine questions, Murgas took advantage, during a break, to ask the German owner whether producing biodiesel was really a good business, and the answer was a strong yes.

Immediately afterward, he called Mario Bernardini, an Italian friend who had installed a refining plant in his company Oleoflores some months before. He entrusted

him with plans for building a biodiesel plant on his land in Barranquilla, and the project became a reality a few months later when the initial steps were taken to develop the plant on the basis of the drawings made by Bernardini, in six different workshops in the Abajo district.

Initially, Murgas considered partnering with Carlos González, a close friend and important oil palm grower in Ecuador. They actually bought used equipment in New York, but the business did not thrive and they abandoned their idea of working together. González persevered on his own, and La Fabril, his company in Ecuador, became the primary biodiesel producer and exporter in that country.

According to the studies conducted by Fedepalma, plant capacity would have to range between 80,000 and 100,000 tons in order to take advantage of economies of scale. But Carlos Murgas chose a capacity of 35,000 tons;[28] moreover, he did not set up the laboratory facilities required for testing and follow-up, a process that is critical for determining flows and potential problems. He would soon realize his mistake when he ran into serious difficulties that he had to tackle along the way as he marched along a steep and painful learning curve. This would eventually help his colleagues avoid the need for learning the hard way.

Thus, as the new plants (requiring an investment 30% higher than estimated) went into commercial biodiesel production, contributing to a vertical integration of more than 90% in the sector, it was the experience gained by the first plant built by Carlos Murgas that sowed the seeds in the fertile new soil of palm biodiesel production in Colombia.

At the end of the day, despite the problems of the initial biodiesel that he obtained, his production plant was the first to start operations in Colombia, specifically in Codazzi (Cesar). President Álvaro Uribe Vélez inaugurated it in November 2007. It runs on the raw material produced by nearly 1,500 smallholders working under the model of productive strategic alliances that Murgas himself promoted when he was the Minister of Agriculture during the first year of the Pastrana administration.

Another project that finally took shape in the coastal region of Colombia – also inaugurated by President Uribe – was that of Biocombustibles Sostenibles del Caribe, belonging to Agroindustrial Daabon Organic, together with Palmeras de la Costa. The government declared it a permanent special free zone in 2007. In

28 Today, his installed capacity is 70,000 tons of biodiesel.

February 2009, only 18 months later, the 100,000-ton production plant went into operation. Another plant built by the Japanese Odin Energy[29] also saw the light in Santa Marta, with an installed capacity of 36,000 tons per year.

In the Eastern Plains, the daring oil palm growers who wanted to adventure into the production of biodegradable soaps stuck together to compete in oleochemicals, but using biodiesel. This is how Bio D S.A.[30] was born in the Facatativá (Cundinamarca) area, with a capacity of 100,000 tons. It was declared a permanent industrial free zone in November 2007, and started operations in February 2009.

The launching of Bio D S.A. was postponed for more than a year due to several factors, and it had to be reprogrammed on a number of occasions. Factors included delays in the declaration of free zone status and in the issuing of the construction license. Moreover, one refining column was late in arriving because the vessel bringing it from Italy faced unforeseen problems at the time of sailing.

Also in the Eastern Plains, in San Carlos de Guaroa, Aceites Manuelita S.A. inaugurated its biodiesel plant in June 2010, with an installed capacity of 100,000 tons per year. It is supplied by close to 20,000 palm hectares planted in that municipality and in other neighboring areas like San Martin, Acacías and other municipalities in the Department of Meta.

In essence, Manuelita was hoping that other companies would join it in building a single plant in the area, and invited the initial partners in Bio D S.A. However, for various reasons the initiative did not thrive.

In the Central Region, after the failed discussions with the coastal oil palm growers, those from Santander joined Ecopetrol S.A., which had already gone public with its interest of partnering with the growers around its refinery in Barrancabermeja. Moreover, its strategic goals for 2015 included producing close to 450,000 tons of their own biofuel (biodiesel and ethanol).

The first meeting was attended by César de Hart Vengoechea, Tito Eduardo Salcedo Díaz, Fabio González Bejarano, León Darío Uribe Mesa, Carlos Contreras, Argemiro Reyes Rincón and Gaspar Rueda Plata, respectively, representing Agroince Ltda., Palmas Oleaginosas Bucarelia S.A., Palmas del Cesar S.A., Oleaginosas Las Brisas S.A., Extractora Monterrey S.A., Palmeras de Puerto Wilches S.A., and Extractora

29 This biodiesel production plant does not have links with the agricultural chain.
30 It brought together 15 shareholders including fruit and oil producers.

Central S.A. The negotiations on behalf of the state petroleum company were carried out by a team designated exclusively for this purpose.

On leaving the meeting, César de Hart said to his colleagues: "Either we do this with Ecopetrol S.A. or we don't do it at all". They all agreed. Then the hard work began, headed by de Hart and Tito Salcedo. In practical terms, they devoted half of their time over 18 months to structuring the business in technical aspects, shares, and contracts, amongst other things.

In the end, the oil palm growers – acting as a block – took 50% of what became Ecodiesel S.A., having an equal slice as that of Ecopetrol S.A. The accomplishment was certainly great, and broke the existing paradigm for public-private partnerships. For the settlement of controversies, should they arrive, the company appointed a three-member committee that would take the final decision.

Moreover, supply contracts for palm oil as the raw material for biodiesel production were drawn up for a ten-year term, as of the moment the plant started operation. This was unprecedented in Colombia. Ecodiesel was created in 2007 and started operations in the second half of 2010.

It would have been thought that a powerful and experienced partner like Ecopetrol S.A. would not have run into problems of delays in setting up a plant for the production of 100,000 tons of biodiesel. Unfortunately, that was not the case: the factory was found to have infrastructure issues just before it received the first load of palm oil and other inputs.

To an anaware reader, the anecdotes about the events that took place during the setup period of the biodiesel plants in Colombia would appear to be the result of sloppiness, carelessness and hastiness in getting to the market ahead of the competitors. But to honor the truth, it must be said that Colombian oil palm producers were in fact pioneers in this industry and, as such, had no instruction manual to follow. Their undertaking, sparked this time by the trust inspired by President Álvaro Uribe Vélez and their own commitment towards their country, was the result of these two ingredients combined to feed the hope of job creation and social wellbeing in the rural areas.

While investment in the oil palm sector boomed in Colombia, the world was on the brink of an unprecedented economic crisis. After five years of substantial expansion, 2008 brought a significant slowdown of the world economy due, among other reasons, to the real estate crisis in the United States, rising commodity prices, and lack of liquidity in the global financial market. The world

stock markets fell, great multinational companies sustained significant losses, and unemployment went through the ceiling in the industrialized countries.

In Colombia, the industrial link in the oil palm chain, faced with the imminent increase in prices of agricultural commodities and the fast development of informal trade and of contraband that threatened to seize a large proportion of the domestic market of oils and fats, decided to create a new Federation to represent it. Asocoingra was established in April 2008 with its membership representing over 60% of the sales of edible oils and fats.

Recognizing that they could not absorb the domestic production of palm oil, they accepted their new competitor for the raw material: biodiesel. In fact, the oils and fats industry joined the new business indirectly through the integrated plantations. Only a few of the traditional industries did not participate, because they had chosen a different oleo-chemical business. Such was the case of Grupo Grasco, which had been conducting research for a couple of years in the field of degradable detergents, a universe that appeared equally or even more attractive to them than renewable energy.

Aceites Manuelita S. A. biodiesel production plant. Photography: López, A. M. (2011).

Although the edible oils and fats industry was not really concerned with the potential shortage of raw material that might jeopardize its production, its main concern was the trend of the domestic prices, which were closely following those of the international market. The price situation at the time – and even today – was different from that of the start of the decade, when TEAM, at the head of the industry, had called for a price reduction.[31] Asocoingra built its case for discussions on the matter with the agricultural producers, who had a new market with huge potential already within their grasp. But this time, its counterpart was very different. Gone were the days when the traditional oils and fats industry had the upper hand in the negotiations.

It was like this because in December 2007 the Government had sent clear signals on the pricing of biodiesel to the oil palm growers who were about to become biodiesel producers. Fuel prices in Colombia are regulated, so getting such signals was no easy feat. Many things happened before the Government decided to adopt the price of the Oil Palm Price Stabilization Fund (FEP Palmero) as the indicator for the domestic market among the three reference price options, and establish it as the baseline for the biodiesel price. Added to it are the efficient production factor, the cost of methanol and a bonus for palm oil quality.

Besides the increase in international vegetable oil prices, a special situation in the local production prevented the supply goals from being reached in 2009 and 2010: the bud rot disease resulted in a reduction of close to 90,000 tons, not to mention the climatological effects from La Niña. The oils and fats industry felt threatened in its inability to access an adequate supply of raw material. This fear led it to mount a fierce attack, like it had done in the early part of the 21st century, against the marketing instruments of the oil palm sector.

Of course, those fears were unfounded, not only because the oils used for biodiesel production would be the surpluses that the oils and fats industry could not absorb, but because the National Government has always prioritized food safety above energy safety, as was clearly stated in the Conpes document 3510.

Besides, although a characteristic of the industry has been to import oils voluntarily, even at times of high domestic harvest, and it had used that as a threat to local farmers in order to force a lowering of the prices, it was actually complaining

31 In 2002, the international oil prices reached a historical low of less than US$290/t. By 2008 they were above a mean of US$943/t followed by a slight reduction in 2009 that placed them at a mean of US$683/t. They increased again in 2010, to an average of US$901/t.

because, in extreme circumstances it might be forced to resort to importation, should the worse come to happen.

A new player in the supply chain

Doubtless, wholesalers played an important role in implementing the Law that mandates the use of fuel diesel/biodiesel blends. They supply the product to the retailers that bring it to the final consumer; in other words, they are a critical link in the supply chain. In fact, out of the initial 5% biodiesel in the blends, they started mixing 3% at their plants, while the petroleum refinery had to mix 2%.

Despite this proportion that would increase as the blend percentage increased, the 17 wholesale distributors and their association (Colombian Petroleum Association) were reluctant to accept the new market conditions. Among other things, their arguments were the high cost of adapting their supply plants, the investments in receipt and storage infrastructure, and the accounting modifications required to account not for one but two products.

In view of the situation, the Government agreed to pay them half a cent of a dollar for every gallon of blend sold in the market, towards infrastructure development and maintenance. Their resistance to change was short lived and, by the end of 2010, they had already adapted their financial and logistic structure and were quite willing to receive the blend increases.

It was surprising, though, that some representatives of the wholesale sector sitting at the committees of the Ministry of Mines and Energy would constantly complain of supply shortages. The biodiesel producers claimed that it was not their fault, and discussions around the issue were endless.

This prompted Fedebiocombustibles to closely follow the biodiesel destined to those wholesalers and asked them to compare data (inventory, purchases, sales, etc.) with those of Ecopetrol S.A. and their suppliers. It was found that not all wholesalers had done their homework of adapting their supply plants and were using the tankers as "stores" for the biodiesel. In practice, this meant, in some cases, that if one tanker load was delivered every day, they would run out of product because they did not have a place to store it. Again, it was made clear that the "villain" of the story was not the newcomer to the energy field, at which fingers were readily pointed every time difficulties arose.

At present, there do not seem to be clear controls in place to determine whether the wholesalers are complying or not with the required blends. They own 30% of

the service stations in Colombia; the remaining 70% belong to 4500 owners, of which 2700 are retailers and the rest are individuals.

Since the biodiesel/diesel blends was implemented in the country, a total of only 25 complaints have been received from among several millions of users.[32] In general terms, problems have not been found to be related to the quality of the biofuel but rather to the poor handling practices throughout the supply chain. It can be seen that it is no good if the biodiesel leaves the production plant under the most demanding quality parameters, which are among the highest in the world, if it is not possible to maintain these quality parameters until the product reaches the end consumer.

It is expected that the Government, in an attempt to solve this issue, will require full compliance with the ICONTEC good practices guidelines from all the agents in the supply chain by the end of 2012.

While this happens, Fedebiocombustibles and Fedepalma are busy organizing days of training for wholesalers and retailers in the different regions of the country, using the guidelines for good handling practices developed by the biofuel producers together with other agents in the chain.

For its part, Fendipetroleo, which groups 70% of the retailers in the country and has supported the biofuels program, also provides training to its associates, and technical advice regarding the adaptation of their service stations.

New best friends

The oil palm sector, overall, has always worked in unity, and its businesses develop together and share information in order to allow some sort of benchmarking that will help increase the competitiveness of the agribusiness. They even discuss their money situation, and have stood together to stop selling to certain purchasers who are tough when it comes to pay. Given this reality, the players in the new business, born from within the oil palm world, were expected to behave in the same way, and so they did.

However, not all the managers of the new biodiesel plants came from within the agricultural sector or knew its habits and it appeared at times, especially at the start, that they did not trust each other. Like in a poker match, one would

32 By November 2012.

throw the card and wait to see what the other one did. That was the kind of atmosphere that prevailed during the initial meetings at the Ministry of Mines and Energy to hear the progress reports on the setting up of the plants.

That changed radically one day when the circumstances forced them to reach an agreement in order to ward off the attacks of the wholesale distributors, during one of these Ministry meetings.

The strategy they agreed upon worked, and bonds of trust and loyalty began to grow among biodiesel producers, who now stood together to defend the sector above and beyond their individual interests. They realized that even if, individually, they complied with the technical specifications and produced premium quality biodiesel, if their colleagues could not do it, the entire sector would suffer because the Government would probably not authorize the increase in the percentage of biodiesel for fuel blends.

What happened next was an example of mutual collaboration. If one producer lacked product or raw material, it would always find another to supply it from its own stock. They have offered advice to each other to overcome technological problems, and even supplied spare parts to each other that are unavailable in the country. They share economic and market information, and they have occasionally also shared clients.

Rarely do they take decisions in isolation. They generally consolidate their ideas, positions and opinions, appointing a single spokesperson to represent them during meetings, either with government agencies or other sectors.[33]

As it happens, in the biodiesel industry everything is waiting to be done. Upstream, oil palm is a world in itself, organized to the point of extraction. But downstream there is a completely different, unexplored universe: nothing has been written, neither information nor real numbers, nor experiences to follow, nor pioneers to show the way.

Not even the much-hailed National Biodiesel Program is documented. There are just a few decrees, some regulations from which the whole story could be rewound in order to start writing it from the very beginning. That is precisely what the National Biofuels Federation is trying to do, lead by its technical director and ICONTEC technical committee head Christie Daza. Fedebiocombustibles accompanies

33 Biodiesel producers are members of the National Biofuels Federation (Fedebiocombustibles) together with the ethanol producers and the sugar and oil palm growers Federation.

the biodiesel producers during follow-up meetings with the Ministry of Mines and Energy and ICONTEC, where quality standards are kept up to date.

The quality issue was complicated because there was no knowledge of how to handle the product competently, maybe because of a lack of specialized literature or relevant and timely information. It should be remembered that there were only a handful of palm biodiesel plants in the whole world.

Thus, every week, all the factory managers had their own sad story to tell: a broken chain, filters clogged with glycerin, a broken centrifuge chain, a boiler lacking sufficient force, palm oil with an acidic smell… Complications took a disastrous turn, in particular for the plants in the rural areas where it took forever to solve all the problems. Wholesalers would then raise their voices asking for the elimination of the blends, given that biodiesel producers were unable to fulfill their obligations.

Tensions were high. Their inability to stop the Government, giving the rightful order to put the blends on hold, placed the biodiesel producers in a very uncomfortable situation. Although there were circumstances explaining their failure to meet their commitments (for example, a truckers strike, a landslide on the road, La Niña phenomenon), their credibility was on the line.

To top things off, late in 2009, Fedebiocombustibles used its entire institutional framework to ask the Government to increase the blend in the coastal region from 5 to 8%, on the assumption that the Odin plant would start operations. Although this plant did not belong to its members, it would contribute a significant volume to the market in order to support the request. The Government agreed and issued the corresponding resolution, but the factory did not keep its promise and no biodiesel was supplied to the new market.

Amidst such circumstances, and having overcome policy issues, the period between 2008 and 2010 was one of technical growing pains for the biodiesel plants. As there would be a change of Government, the next step was to determine if the new President would support the energy and rural incentives policies of his predecessor.

Between 2010 and 2011, biodiesel producers focused on trying to stabilize the delivery of a quality product and prevent market shortages. Fedebiocombustibles created a committee where plant managers got together to make decisions, outline strategies and establish courses of action.

The existence of a public and private institutional structure was pivotal in bringing together synergies and know-how to implement a law in a very short period of time. In fact, only four years passed between the date on which it was approved

and its materialization in the local market with the sale of the first gallon of palm biodiesel mixed with fossil fuel. The leadership of the business sector, the focus on quality, the achievement of top technological standards, and constant monitoring were the key success factors, although the most important of all was the ability to build trust among all the parties in the chain and its users.

And the new Government?

As mentioned in the previous chapter, the Santos administration has taken uncertain steps regarding the biodiesel policy developed so successfully during the first years of the Uribe administration.

One such step was the agreement with the European Community in the form of Decree 4892 of December 23rd 2011, which modified Decree 2629 of 2007 that instituted up to a 20% increase in the blends. The new decree not only eliminated the percentages that were so annoying to the powerful economic block, but also conditioned blend increases above 10% to prior consultation with the Intersectorial Biofuels Commission, presided by the Ministry of Agriculture and Rural Development. Moreover, it enabled the Government to authorize the parallel use of other fuels in exceptional circumstances, and even reduce blend percentages below those already established.

Those advantages were granted because the Europeans refused to sign a free trade agreement with Colombia if biodiesel levels were not reduced. In some regions, those levels are greater than 7%. The European Community government was trying to protect its automotive industry, because big brands such as the well-known Audi threatened to remove their exports of diesel-engine vehicles to Colombia, on the grounds that they could not guarantee adequate performance of their engines above that percentage.

It is difficult to understand how the National Government agreed to such baseless demands, despite the fact that Fedebiocombustibles warned it about the hard blow it would give to investor trust and to the credibility of the National Biodiesel Program. It was a change in the rules of the game, developed with so much zeal and discipline with the view of benefitting the agricultural sector and protecting rural employment, diversifying the energy mix and promoting a healthier environment.

A careful examination reveals that the European Community practically ended up legislating in Colombia when it managed to limit not only the biodiesel/diesel

blends but also the ethanol/gasoline blends.[34] This is even more striking when considering that it is this part of the world that is well known for promoting and increasing the use of biofuels. This is especially true in Germany – birthplace of Audi – where drivers fuel their engines with voluntary blends containing even more than 20% biodiesel.

However, that is not the only threat that looms over the fledgling biodiesel industry, which, so far, has seen no return on its investments. The possibility of importing biodiesel from the United States is another threat because, unlike the Europeans, the Colombian government did not take any steps to protect local production. As will be discussed in a later chapter, Europe forbade the entry to its territory of palm biodiesel, but not of palm oil, which could ultimately mean that the latter could be returned to a producing country, including Colombia, in the form of biofuel.

It would appear then that the fears of the oil palm growers in undertaking an industrial enterprise requiring huge investments were not unfounded after all, considering that in a country like Colombia there is no continuity in government policy, at least not for domestic investors. In contrast, for foreign investors there are always interesting promises.

Despite the uncertainty created by the present administration, businesses continue to place their wagers on the new market, all the way from planting to production of the biofuel. They are opening the way for others that may want to follow, because biodiesel is a new undertaking, not only in Colombia but in the rest of the world. There are no recipes or winning formulas that offer a road map for newcomers. Even less in palm oil, because the more experienced nations, namely the Europeans, manufacture their biodiesel from other raw materials like rapeseed or sunflower, which they grow in their own backyard.

34 The revised decree established that, by 2012, new vehicles of less than 2,000 cubic centimeters should have engines that could use a blend of up to 85% ethanol. This would be obligatory for 60% of the models of any brand; the percentage would rise to 80% by 2014, and to 100% by 2016.

Photography: Courtesy of Bio SC S.A.

Biocombustibles Sostenibles del Caribe S.A. Biodiesel plant
Location: Santa Marta, Magdalena. Capacity: 100,000 t/year. Inauguration: February 2009

Chapter 4

Receiving lines for oil palm biodiesel at the blending station.
Photography: Gutiérrez, R. y Holguín, J. L. (2008).

Conclusive evidence

The future has many names:
For the weak, it means the unattainable.
For the fearful, it means the unknown.
For the courageous, it means opportunity.
Víctor Hugo

On February 28th 1892, Rudolf Diesel received his patent for the "veggie" engine that made him rich and famous. When he exhibited it in Paris, he decided to use 100% peanut oil, although the engine was designed to work with other types of fuels as well, fuels that have made their comeback, challenging the hundred year-old reign of their fossil counterparts. This is due to the pressure of high oil prices on the world economy and the establishment of a new global order favoring the environmental protection of our planet.

Ignition in this internal combustion diesel engine happens because of the high temperature created by air compression inside the cylinder. The fuel is injected under high pressure into the combustion chamber and is blended with air, which is at an equally high temperature (between 700 and 900 °C). As a result, the mix ignites readily and causes expansion of the gas contained in the chamber, which, in turn, pushes the piston downward.

For years, diesel engines were heavy, noisy and sluggish compared with gasoline engines, limiting their applications. However, they have regained popularity with the arrival of new technologies, such as the turbo compressor or direct injection.

There are four-stroke and two-stroke diesel engines on the market. The former are more widely used in automobiles, and the latter in marine vessels and for railway traction. Perhaps their greatest advantage over gasoline engines is low fuel consumption, although their price has increased as a result of greater demand, in particular since the 1990s.

Essentially, biodiesel is a biofuel derived from used or new vegetable oils and animal fats, subjected to trans-esterification. This procedure, developed by E. Duffy and J. Patrick in the mid-19th century consists of adding alcohol (ethanol or methanol) to transform fats into methyl ester (biodiesel) and glycerin in the presence of a catalyst. Although biodiesel was used to move heavy vehicles in Africa before the Second World War, and some European countries tried to promote its use, it did not gain popularity, merely for economic reasons. It was only in the early 2000s, when the prices of fossil oil and vegetable oils began to even out that the latter regained their appeal for energy production.

The most attractive characteristics of biodiesel include better lubricant properties and a much higher cetane[1] index than that of low sulfur diesel.[2]

Biodiesel is liquid at room temperature and its color varies between gold and brown.
Photography: Gutiérrez, R. and Holguín, J. L. (2008).

1 The cetane index is related to the delay between fuel injection and the start of combustion (ignition interval). A high cetane number results in improved combustion and a smoother and more regular engine performance. The higher the cetane number, the shorter the ignition interval and the better the combustion quality.

2 Sulfur is a diesel component not found in biodiesel. Due to its negative environmental effects, it is regulated throughout the world because it promotes acid rain and particulate emissions. Some of the pollutant gases (nitrogen oxides and sulfur dioxide in particular) react when they come into contact with air humidity and become sulfuric acid, nitric acid and hydrochloric acid that build up in the clouds. The rain from those clouds contains small acid particles, hence the name "acid rain".

At room temperature, it is fluid and its color ranges between light gold and dark brown, depending on the raw material used. It is less dense than water and is immiscible; it has a high boiling point and low vapor pressure. Its flash point at 130 °C is much higher than that of diesel (64 °C) and gasoline (-40 °C).

Petroleum-derived fuels used in diesel engines contain only hydrocarbons.[3] In contrast, biodiesel, aside from hydrogen and carbon, also contains oxygen.

For some years now, biodiesel has been mixed with traditional diesel to run certain types of vehicles in several countries. The biodiesel/diesel combination reduces fuel circuit wear significantly and, in high-pressure systems, it extends the life cycle of the injectors, highly reliant on fuel lubrication. Biodiesel has excellent lubricant properties, a characteristic which is by no means negligible considering that diesel fuels with less than 500 parts per million (ppm) of sulfur lose those characteristics and require additives. They regain those properties when biodiesel is added in proportions equal to or greater than 2% (B2).

In order to produce biodiesel, countries generally use the raw materials grown on their own soils. For example, Germany, Austria and other Central European nations derive it from oil seeds such as rapeseed and sunflower. The United States and Argentina, two of the largest world producers of soybean, use that source as their raw material.

In Colombia, that role falls on oil palm, with a yield per hectare many times higher than that of other oil seeds. On average, the 4,000 kg of palm oil produced per hectare per year is 5.4 times the yield of rapeseed, 7.6 times the yield of sunflower, and 9.5 times the yield of soybean.

Palm biodiesel, like other biodiesels produced from other oils and fats, does not contain sulfur, is biodegradable, and has a more favorable energy balance than others of its type: six to eight energy units generated for every unit of energy used.

The production in form of biodiesel was envisioned in Colombia in 2004, when the National Government, led by Álvaro Uribe Vélez, was busy promoting the activity on the grounds of its multiple benefits. At the time, Law 693 of 2001 – better known as the alcohol fuel law – was fully in force, hence a successfull biofuel project was already under way when President Uribe urged oil palm growers to enter the business.

3 Hydrocarbons are composed of hydrogen and different classes of carbons, such as alkanes, alkenes, alkynes, aromatics and others.

It was not long before the growers designed their own strategy to learn about this new target industry, in response to the President's challenge. The first thing they did was to commission in-depth analyses on the feasibility of the development of this new product.

They also referred back to old discussions with different people who had visited the oil palm growers' association in order to show their progress studying biodiesel, and in addition they looked for others who had been working on the subject. The technical and scientific aspects were uppermost in their minds at the time.

As the oilseed plant with the highest oil yield per hectare, oil palm became the raw material of choice for biodiesel in Colombia. Photography: Toro, F. (2009).

Initial local experiences

The academia

One of those discussions took place in the year 2000 with John Agudelo from Universidad de Antioquia and Lesmes Corredor from Universidad del Norte. At that time, the academics met with Fedepalma's Executive President, Jens Mesa Dishington, and Presidential advisor Álvaro Silva Carreño. Their idea was to present their visions of biodiesel and discuss the potential of palm oil as the raw material to make it; moreover, they came armed with hard data because they had already produced 80 liters of biodiesel using palm oil,[4] which they had tested in laboratory engines at the Universidad de Antioquia.[5]

The leaders of the oil palm growers' Federation listened but did not give much hope to the researchers regarding any kind of advancement with them, because the existing situation of the sector was unfavorable. However, a year later and with the help of Ecopetrol S.A., Colciencias approved a 300 million project, which included the participation of Professor Pedro Benjumea, from Universidad Nacional. It consisted of using palm oil to optimize the three phases of biodiesel production: olein (liquid), estearine (the most solid phase in cold environments), and crude oil.

The main achievement was a laboratory-made biodiesel, which complied with the German standards, at the time the only ones available in the world specifically for biofuel. Then came the production of a batch of 300 liters of oil palm biodiesel with the support of Interquim,[6] an Antioquia-based company. The fuel was produced at their facilities and then delivered to the university for testing.[7]

After such an initial feat, Interquim sold a significant quantity of biodiesel to Cenipalma[8] – the scientific arm of Fedepalma – in 2005. Under the leadership of Mónica Cuéllar Sánchez, the leader of the recently created Alternative Uses Unit (Fedepalma), specific tests were conducted together with the Colombian Oil Institute (ICP).

4 Donated by Palmeras de la Costa.

5 To learn how to produce it, they had used Fedepalma's Information and Documentation Center (CID Palmero), to which Jens Mesa Dishington had recently given the documents he had brought from Malaysia, where doctor Choo explained the procedure in detail.

6 Today AkzoNobel.

7 Methanol, indispensable for the production of biodiesel, cannot be shipped by road in Colombia. Consequently, biodiesel – free from such restrictions - had to be produced at Interquim.

8 Colombian Oil Palm Research Center.

In 2003, the same professors from Universidad de Antioquia, Universidad del Norte and Universidad Nacional had another important achievement: biodiesel could be produced from castor oil and from used deep-frying oil supplied by the Intercontinental Hotel in Medellin, where the practice is to use the brand new vegetable oil only once and then discard it.

The curious part of the case is that they did not know that in Colombia there is an illegal market for used-oil. This is packaged and sold as a product, especially to street vendors of fried foods who gather around football stadiums. The academics believed, on the one hand, that their scientific contribution could stop what the Empresas Públicas de Medellín called "sewer cholesterol" – because much used cooking oil ends up there and damages the sewage system –, and on the other hand, they could offer motor vehicles an alternative source of cheap fuel. However, the intensive demand from the street fried food vendors deprived them of the raw material they needed to make the dream come true.

This research doubtless was essential for the development of biodiesel as a renewable fuel in Colombia, as was also the research from others like Universidad Industrial de Santander (UIS) that approached the topic conscientiously.

The Institutions: Ecopetrol S.A.

Ecopetrol S.A. and its Colombian Oil Institute (ICP, for its acronym in Spanish) had supported the academics by "grounding" their ideas in specific projects. As soon as the first batches of biodiesel were obtained in 2003, they began their testing in the laboratory, in engines, and in motor vehicles.

In this way, Ecopetrol S.A. and the academic researchers began supporting the legal groundwork of the Ministry of Mines and Energy using reliable experimental data and results.

At the same time, Fedepalma commissioned its study on the technical and economic prefeasibility for the production of crude palm oil by-products as fuels for diesel engines in Colombia.

That is to say, that several public and private stakeholders were not only thinking about the idea but were also committed to rigorous research that would serve as a foundation for biodiesel technical standards, laws, and regulations, also in the making.

Ecopetrol S.A. had refused to enter the ethanol business, but was willing to do the opposite with biodiesel, hence its decision to entrust ICP with the task of

assessing the impact of biofuels on the fuels market. The Institute did this as well as partnering with Sí 99,[9] Corpodib[10] and SENA[11] to start the tests. Later on, it would also partner with Fedepalma and Cenipalma. It could not have been otherwise, the Ecopetrol S.A. team was convinced of the need for periodic testing for any form of new fuel formulations, not only of the physical and chemical properties, but also of their impact on vehicles, engines, on greenhouse gas emissions,[12] etc.

The ICP had learnt the lessons from its experience with ethanol, which it was unable to test under long-term conditions because there was no product availability, given its use in the exclusive monopoly of liquor production. It had conducted only short tests based on international experience, particularly that in Brazil and the United States.

In the case of biodiesel, Interquim was producing sufficient amounts, but of course, at a high price. Using this biodiesel, ICP run short-term, workbench and route tests as well as tests on the chassis of the vehicles.

Sí 99, Transmilenio Operator

Transmilenio, the Bogota mass transportation system, began operations in 2001 as a means of massifying urban passenger transportation. Since the fleet of articulated buses operates with diesel engines, displacing countless gasoline-fueled buses, taxis, and light and semi-heavy vehicles, the demand for motor gasoline dropped by 470 barrels per day (bpd). The expectations for Transmilenio are to mobilize 5 million passengers per day by 2016.

One of the seven operators of the system, in charge of purchasing and operating the buses, is Sí 99, which takes its name from the "Sí" ("Yes") given in 1999 by the mainstream transporters for the city's modernization, an undertaking led at the time by the district government. They also agreed to search alternatives to fossil fuels, and honored their commitment by opening the door to research in the form of eight innovative projects, half of them related to fuels.

9 Transmilenio Operator.

10 Corporation for Industrial Development of Biotechnology and Clean Manufacturing.

11 National Technical Education System.

12 Due to indiscriminate use of fossil fuels, these gases pose perhaps the greatest threat to mankind with their significant impact on global warming. The best known is carbon dioxide (CO_2), but there are others like water vapor, methane, ozone and nitrogen oxides.

In 1999, the engines of the fleet were Euro 0,[13] which meant they were causing high levels of pollution. The decision to change to Euro 2 was a significant step at the time. Additionally, a microfiltration process was implemented in the fuel stations in order to reduce the effect and opacity of the fuel still further.

The projects directly related to biodiesel production were undertaken jointly with Corpodib, Colciencias and Universidad Nacional, with the idea of taking advantage of animal fat recovery for fuel, using recycled cooking oils as the raw material.

Following the suggestion from David Cala Hederich, from Corpodib, it was decided that the best thing was to use new oil. In 2001, a pilot plant was assembled at the Usme Transmilenio yard[14] for the production of oil palm biodiesel using anhydrous ethanol.

The pilot plant started operations in 2003 and became the first in its class in the country. It was co-financed by SENA and Sí 99. Corpodib and the Department of Chemical Engineering of Universidad Nacional – where preliminary laboratory tests were run – had the technical supervision on charge.

At the time, there was no motor vehicle assembly plant willing to participate in the tests, so they had to be run in stationary engines at SENA. They consisted of measuring power, torque, performance, fuel consumption and particle emissions.[15] Diesel biodiesel blends ranged from B10 to B70, and it was found that losses in torque[16] were much less than when biodiesel from recycled animal fats were used. Tests were then conducted in a Chevrolet 2.2 diesel truck.

13 The Euro standards seek to regulate acceptable limits for combustion gas emissions from new vehicles sold in the member States of the European Union, including automobiles, trucks, trains, tractors, similar machines, and barges. Maritime vessels and aircraft are excluded. These are the most restrictive standards in the world, and their implementation is progressive, ranging from Euro 1 (the least restrictive) to Euro 6 (the most restrictive), that will enter into force in 2015. Euro 5 prevails at the moment.

14 The system includes yards and garages equipped and maintained by the Capital District, where maintenance takes place and where the buses are parked at the end of the operation. Usme is one of the 20 locations in Bogota.

15 Set of solid or liquid particles (except for pure water) suspended in the atmosphere.

16 The term relates to the moment of force applied by the engine to the power transmission axle.

Biodiesel pilot plant for running tests in the mass transportation system (Transmilenio) in Bogota. Photography: Gutiérrez, R. and Holguín, J. L. (2008).

Las Gaviotas

Las Gaviotas Experimental Center Foundation is located in Vichada, the second largest Department of Colombia after Amazonas. It is one of the attractions in the high plains because of the type of alternative energy research and applications it has developed, including a bioclimatic house, windmills and solar energy installations.

The Bogota facilities are located on the mountain, close to the ring road. Director Paolo Lugari set up a biodiesel plant there in 2004 in an agreement with the University of Colorado (United States).

Once the plant was installed, a lorry arrived with crude palm oil from Unipalma, the company where they used to buy the product, and it was impossible to pump it. The reason for this being that at the altitude of Bogota, palm oil becomes semi-solid and looks like lard. Paolo Lugari melted the oil with the help of a small steam boiler, but the product would become emulsified, requiring reheating.

Nonetheless, the initial tests were done with non-trans esterified crude palm oil in a new Corsa car[17], which proudly exhibited the sign "Fueled with vegetable oil" on its doors.

The car had to start running after nine in the morning, when the sunshine had warmed the city sufficiently for the oil to melt. Before that time, it was just impossible to switch on.

Once the biodiesel itself was produced, which was blended up to B60, the tests were successful. Two years later, the plant was sent to Las Gaviotas in Vichada, where fuel was produced only for domestic use.

Either way, for Gaviotas palm biodiesel is already history. Three years ago they found that it was possible to obtain it from resin of Caribbean pines, of which they have 8,000 hectares planted in Vichada. They do this by physical, non-chemical processes, so no glycerin is obtained as by-product, only biofuel.

It was imperative for them to find an alternative to avoid the need to transport methanol for biodiesel production to a Colombian department fraught with unrest and planted with illegal crops. They have given their discovery the generic name of "biofuel", because they also combine it with gasoline for use in Otto

17 Loaned by General Motors for the tests.

engines[18]. So they call it biodiesel or bio gasoline, depending on the engine in which they use it.

At the present time, they operate their eight tractors and three diesel generators with biofuel derived from Caribbean pine; and they run Otto engine cars in Bogota with 30% biofuel and gasoline blends. In order to solve the problem of altitude in Bogota, where the appearance of the biofuel changes and it is difficult to start the engines, they decided to use spark plug preheaters and leave the ignition on for one minute. Problem solved!

Ecología y Entropía Ltda.

Before conducting the study for Fedepalma together with Arturo Infante, Eduardo del Hierro's company *Ecología y Entropía* had been experimenting to determine the technical viability of blending biofuels with diesel. The goal was to use diesel engine testing workbench in Bogota, taking into account that the altitude and temperature in the city create special combustion conditions.

The research focused on the use of blends with two and three components: diesel, ethanol and one palm oil by-product (crude palm oil, refined, bleached and deodorized palm oil – RBD – and palm olein). Trials for the preparation and initial use of these blends in diesel engines belonging to the Department of Mechanical Engineering of Universidad Nacional in Bogota showed that water-containing ethanol cannot be used, but only anhydrous ethanol up to 2.5%. Because of cost considerations, the goal was to use blends and avoid trans esterification. The final blends used in the research had a 2.5% ethanol content plus 7.5% palm oil derivatives mentioned above, for a maximum of 10% biofuels.

The research, sponsored by Manuelita S.A., was conducted in partnership with Universidad Nacional, working in parallel with other universities under the leadership of professors Helmer Acevedo and Néstor Rojas.

Eduardo del Hierro was also present during the commissioning of the biodiesel test plant at Las Gaviotas, and witnessed the first few trial days when the Corsa car ran on 100% non-trans esterified palm oil.

18 In 1886, the German engineer Nicolaus August Otto invented the internal combustion engine (gasoline), also known as the "Otto cycle engine" or "spark-ignited engine".

Fedepalma: Team-building as the groundwork for the future

When President Álvaro Uribe spoke for the first time about biodiesel during the 2004 annual palm grower's congress, they were not ignorant on the subject. In fact, they had already set up a team of professionals from Fedepalma and Cenipalma to study the technical, economic, environmental and legal considerations required to bring the project to light. They had even invited the professors from Universidad de Antioquia, Universidad del Norte and Universidad Nacional to exhibit an engine that ran on oil palm biodiesel in the patio of the Cartagena Convention Center, venue of that year's event. After his speech, the President would be invited to see the engine running.

The initial approach to biodiesel by palm oil producers took place during a meeting organized in December 2000 by the late Miguel Angel Mazorra, director at the time of Fedepalma's Environmental Unit. During that meeting, David Cala Hederich from Corpodib spoke about palm oil and its by-products as an alternative for the production of fuel alcohols and biodiesel.

Later, in 2003, LMC International[19] expert James Fry was retained to conduct a study on the potential of biodiesel. So interesting were the results that oil palm growers decided to undertake a technical study, this time led by Arturo Infante Villarreal and Eduardo del Hierro, who presented the final report in August 2004. In October of the same year, Fedepalma organized a technical mission to Malaysia so that palm growers and other stakeholders could appreciate for themselves the state of the art of biodiesel in that country, the largest oil palm producer in the world. Few months before, Fedepalma had created its own Marketing Unit, which was working closely with the newly created Alternative Uses Unit of Cenipalma. The two units were represented in that mission.

During the visit, oil palm growers and government officials[20] alike realized that it was possible to produce palm oil biodiesel and that the technology was already in place. In fact, the Malaysians had already tested their products in vehicles that one decade earlier had covered about 10 million kilometers on B0, B50 and B100 blends.

Between 2005 and 2006, Cenipalma and ICP performed the initial practical work on biodiesel in order to determine if it met the specifications for diesel fuel as

19 English company specialized in financial and business consulting for the agribusiness sector.

20 The government representatives were Jaime Augusto Torres Novoa, from Ecopetrol S.A., and Julio Cesar Vera, from the Ministry of Mines and Energy.

well as to sustain the quality standard. The product did very well, as shown by the stand test results in Chevrolet vehicles loaned by General Motors Colmotores (GM), and in Transpiedecuesta buses.[21]

It was the first of a series of agreements between the Federation and Ecopetrol S.A., and would become the corner stone for the joint development of the biodiesel quality standard with the other stakeholders in the chain who were present at the ICONTEC[22] Committee 186.

The field tests were next. They were designed to verify the performance of biodiesel in action in the articulated Sí 99 Transmilenio buses over a total distance of 1 million kilometers on the streets of Bogota.

Finally, long-term tests were to be conducted on a fleet of trucks carrying cargo across the country. They covered 100,000 kilometers each, using B5, B10 and B20 blends. The goal was to demonstrate that in typical Colombian road conditions, reaching heights of more than 3,000 meters above sea level at times, the performance of the truck engines would not be affected.

The tests begin

Tests. Scientific rigor. Studies. Data. Results. These are the sole underpinnings for any sound argument, in particular when it comes to building a case for technology. Fedepalma knows it and it has always acted accordingly. Its inquisitive vein resulted in the creation of Cenipalma in 1991, later to be entrusted with the research on oil palm biodiesel, which started with a trip to Malaysia, followed by a series of studies and tests. Cenipalma was also there to support the development and implementation of a stringent technical standard, as well as the verification, in the field, of the results obtained under controlled conditions in the laboratory.

Three tests were conducted in total, following stringent research phases that yielded irrefutable results. They included, (a) Evaluation of palm oil and biodiesel blends with diesel fuels; (b) Long-term tests using oil palm biodiesel in public transportation buses; and (c) Long-term tests using oil palm biodiesel in freight trucks.

21 Transportation company from Piedecuesta, Department of Santander.
22 Colombian Technical Standards and Certification Institute.

The first test: paving the way for technical standards

Clear guidelines and strategies had been established from the very beginning of the well-documented adventure into which the oil palm growers had embarked. One such strategy consisted of finding partners with knowledge of fuels and the fuel business, a matter in which they were truly ignorant.

Fedepalma recognized the need for investing in demonstrating the viability of palm oil biodiesel if it was to get ICONTEC to produce a stringent technical standard model. And that is what it did, working practically from scratch, because the biodiesel industry was relatively new in the world at the time. The most experienced in the industry were those that used rapeseed and sunflower as raw materials, while those that used oil palm were in a fledgling state, commercially speaking.

With this in mind, Fedepalma asked Cenipalma to approach Ecopetrol S.A., since some of its employees had been on the technical mission to Malaysia and were among the advocates of the biofuel project.

After four months of discussions and drafting of the agreement, it was decided that Cenipalma would provide technical and administrative support because, as a private entity, it would have greater flexibility and advantages, for example with buying and hiring, something that Ecopetrol S.A., as a state agency at the time, would not have.[23] Work on the project began in August 2005 with the aim of characterizing oil palm biodiesel, palm oil (crude, bleached and refined), and blends with regular,[24] premium[25] and hydro treated diesel (HTD).

At the same time, Cenipalma and ICP approached ICONTEC to start standardization work on biodiesel. Although positive, the response would be subject to the availability of the necessary technical support. It was the first experience for the oil palm organization in an area that, until recently, had been alien to it. But with the support of the state-owned company, recognized in the world for its research and contributions to new fuel formulations, the Federation was not feeling alone, but rather supported and encouraged.

23 The organizational structure of Ecopetrol S.A. (Colombian Oil Company) was modified in June 2003 under the new name of Ecopetrol S.A., a publicly traded corporation. This transformation meant that it would no longer have to play the role of state administrator of the national oil resources. A new agency was created to take over that role: the National Hydrocarbons Agency (ANH).

24 With a content of 4,000 ppm of sulfur.

25 With a content of 1,200 ppm of sulfur.

The Colombian Oil Institute is situated in Piedecuesta (Santander) and it was there that the diesel engines and buses and other vehicles on its testing workbench would use the newly produced biodiesel.

The first oil came from Puerto Wilches. It was crude palm oil donated by Oleaginosas Las Brisas. When the Ecopetrol S.A. officials opened the drum, they were surprised when they saw something that looked like lard. They immediately thought that it had been tampered with, and called Cenipalma demanding prompt action. They would learn later that crude palm oil is semi-solid in its natural state, but that was no obstacle for the proposed tests.

Some days later, ICP received the white liquid oil it had been expecting, but the next time, although in the same state, it was orange. Again, they called Cenipalma for an explanation. As it happened, the first batch was refined, bleached, deodorized palm oil (RBD), and the second was the naturally orange-colored crude olein, the liquid palm oil fraction.

Interquim, a company based in Girardota (Antioquia) supplied the biodiesel. It was produced from the raw material donated by Santandereana de Aceites, located in Bucaramanga. This was a big challenge considering that this palm oil company handles close to 100 tons in bulk per day and the project required that it only deliver 1 ton to Interquim. The transport logistics from Bucaramanga to Medellin and finally to Girardota was difficult and, consequently, expensive.

When all the ingredients of the solution were ready in the laboratory of the state oil company, two people hired to do the work made the blends and conducted the tests and the necessary analyses, under the supervision of both Cenipalma and ICP. In fact, more than the minimum required analyses were conducted and it was found that diesel-biodiesel blends worked well and behaved similarly to fossil diesel, except for the blend from crude palm oil, which could not be used directly as fuel.

The blends were tested not only in ICP's diesel engines, but also in the dynamometric chassis in the laboratory, used for testing torque and power. They were also tested in other vehicles, one Daimler Chrysler, two from GM Colmotores and two mini- buses from the Transpiedecuesta Company, all with different levels of use, maintenance and diesel engine types.

However, it had not been easy to persuade these companies to lend their vehicles for the research. They had to be given assurance that no damage would be caused and that, if something happened, the project would cover the repair costs.

The initial partnership between Cenipalma and Ecopetrol S.A. produced many benefits as a result of the synergies created. Fossil fuel producers came to know and understand the oil palm industry and, in turn, oil palm growers came to know and understand the fossil fuel industry. For the latter, so great was the novelty, that visiting ICP in Piedecuesta – which they certainly did over the course of the project, represented by the board of directors of both Fedepalma and Cenipalma – and seeing the testing workbenches, the engines, etcetera, was like paying a visit to NASA.

For the fossil fuel producers, getting to know vegetable oil as a raw material for fuels was not only new technical knowledge, but also awareness of the social, economic and environmental benefits of oil palm for the country as a whole. Both teams, therefore, became involved in the other's activity, and the result was a partnership, which went beyond the boundaries of mere technical work and became the fundamental pillar for the creation of the first biodiesel regulations in Colombia.

Oil samples being checked under the supervision of Cenipalma and the Colombian Oil Institute. Photography: Gutiérrez, R. y Holguín, J. L.(2008).

With the convincing results of the initial characterization tests of blends of palm oil and oil palm biodiesel with diesel under their arm, Fedepalma, Cenipalma and Ecopetrol S.A. approached ICONTEC early in 2006. They informed Technical Committee No. 186 on Fossil Fuels and Ethanol that they had done their homework and were ready to help build the quality technical standard for biodiesel.

The monthly meetings were far from easy. The automotive sector, represented in this setting by the Automotive Chamber of the National Entrepreneurs Association (ANDI, for its acronym in spanish)[26] and by GM Colmotores, raised countless objections based on information received from the United States and Europe that biodiesel had not been successful, including pictures of clogged filters.

Cenipalma and ICP presented their strong arguments and explained, point-by-point, each of the parameters they had constructed to measure the quality of biodiesel in Colombia, and which they were putting forward for the Committee to consider for approval.

The most heated debate revolved around the issue of the pour point[27] that would determine the acceptance of biodiesel as such: the automotive sector wanted it at 3 °C, which meant that oil palm biodiesel would be unable to meet the requirement.

Cenipalma and ICP went looking for the resolutions prevailing in other countries regarding this point, and found that they all include an annex on the pour point, which is dependent on the characteristics of each country, the climate, the season, etcetera.

For example, the European requirement specifies the pour point for each country and for each season (winter, summer, autumn and spring). Cenipalma sought to persuade the committee that a fixed pour point could not be included in the ICONTEC standard because of its dependence on variables like those mentioned above. Moreover, the results of the tests conducted jointly with Ecopetrol S.A., showed that, in the blend, the behavior of the pour point was due to the diesel component and not to the biodiesel, and it was always below 3 °C. Consequently, the pour point of pure biodiesel was really unimportant if it did not affect the end product in the blend.

26 Working group consisting of vehicle assembly companies, auto parts producers and motorcycle assembly companies. Its mission is to conduct activities aimed at fostering the industrial development of the sector.

27 The pour point is the temperature at which biodiesel forms a cloud when it cools; it is a measure of the freezing point.

This battle ended in victory, precisely because it was supported by conclusive scientific arguments and because it occurred among highly professional organizations and individuals who, moreover, wanted to build empathy with their peers. In fact, they broke the traditional forms of those typical meetings at ICONTEC, and each sector played host on its own premises. Committee meetings took place on the premises of Sí 99; at Aceites Manuelita S.A. – where Cenipalma showed the entire milling process of the oil palm fruit; at ICP – which showcased the petroleum technology; and finally at the Colmotores car assembly plant, the largest in the country.

In any case, once agreement was reached and while the Colombian Technical Standard NTC 5444 was refined, vehicle importers asked the oil palm sector and Ecopetrol S.A. to conduct road tests. They considered that the evidence on the performance of automotive vehicles using biodiesel/fossil diesel blends was insufficient.

Consequently, the two organizations called on the automotive industry to take up the challenge of loaning their vehicles for research. The decisive meeting gathered representatives from GM Colmotores, Volkswagen, Mercedes Benz, in other words, all those members of ANDI who had an interest. None of the importers or assembly companies accepted the challenge. The only company that was willing was Sí 99, the Transmilenio operator, which became their partner in the long-term tests that would eventually show to Colombia the technical and financial viability of oil palm biodiesel.

The second test: a truth is confirmed

A number of road tests had been done in Europe, but using rapeseed biodiesel. These tests did not convince the automotive manufacturers because of issues with "gum" formation and its production was not certified as was also the case in the United States, where, inclusively, even today there are people who make their own fuel blends at home for use in their vehicles. Not surprisingly, automotive companies vetoed some blend percentages in renewable fuels, particularly biodiesel. So it was no easy job to persuade them to honor their warranties on the engines of the vehicles used for long-term testing. Someone had to run the risk; and it was Sí 99 that did so, because the manufacturer of its articulated buses, Mercedes Benz, refused.

Sí 99 had been working since 2002 on the construction of a pilot plant for the production of oil palm biodiesel in conjunction with the company Corpodib at

the Usme terminal, a location which was also a bonus for the project. So Fedepalma, Cenipalma, Ecopetrol S.A. and Sí 99 partnered and initiated their ambitious undertaking only a few days after Colombian Technical Standard 5444 was made public in 2007. The test consisted of covering 100,000 kilometers in Bogota with twelve Transmilenio buses using B50 blends, for a total of 1,200,000 kilometers. As with the first agreement, Cenipalma was again entrusted with managing the project – under the leadership of Jesús García Núñez[28] with the support of researcher María Antonia Amado – and dealing with matters like hiring, construction, buying, etcetera.

Engineer Carlos Terraza from Sí 99 had made progress in biodiesel research and had developed the project design for the long-term tests when Daniel Cabuya joined the transportation company in 2007 as maintenance manager, and took the lead in structuring a project team with the other participating organizations.

The initial enthusiasm was stifled by red tape and hindrances imposed by the Technical Administrative Department for the Environment (DAMA, for its acronym in Spanish), as well as by the Bogota Environmental Secretariat and the Urban Development Institute (IDU)[29] because environmental and other necessary permits had to be granted before the project could be started. The apathy of these agencies, particularly the former, set the project back by nine months. A similar delay was caused by the need to restructure the project, given the exceedingly high costs associated with the unnecessary management of a large infrastructure for the production of the blends in the desired proportions.

The local authority did not approve the initial pilot plant design because the fuel storage tanks were above the ground. In order to solve the problem, an infrastructure was developed in the Transmilenio yard in Usme, taking into consideration the need to ensure the quality of the fuel as well as compliance with the specifications required by the market. The new layout included two storage tanks (one for fossil diesel and the other for biodiesel), a system for receiving fuels, and a blender,[30] which Daniel Cabuya from Sí 99 obtained from Terpel. With this method, the cost of the investment dropped by 20-30%.

A few months before, Ecopetrol S.A. had entered into an agreement with Transmilenio to create a protocol that would analyze fuel performance, but not for biodiesel.

28 Coordinator of the Processes and Uses Program in Cenipalma.
29 IDU is the owner of the Transmilenio structure.
30 Electronic control system for preparing the blends and delivering the fuel directly to the buses.

The goal was to determine whether the service provided by the articulated buses (express or regular) had any impact on fuel consumption at the altitude of Bogota.[31]

So, in 2007, employing the protocol at hand of a *stop-and-go* measurement methodology that generates changes in fuel use, as well as utilizing the plant already in operation at the Usme yard, the venture of travelling 1 million kilometers with articulated buses using different proportions of biodiesel began.

Then another challenge appeared for the entire industry: handling biodiesel under the climatic conditions prevailing in Usme – with temperatures below 10 °C. To overcome the problem, a special design was developed in order to allow storage at temperatures above 20 °C under strict safety conditions, avoiding cost increases. Although this design was not passed on to the distributors, it helped demonstrate biofuel handling at low temperatures.

The issue is that, in order for biodiesel to remain in a liquid state, it must be stored at a temperature 6 °C higher than its pour point, depending on the original raw material. In the case of oil palm biodiesel, that temperature is 20 °C.[32]

The test was planned to last for 14 months, but all delays were offset when the buses were able to run 30% more per moth, allowing the test to be completed in less than one year.

The end of the first part of the trials coincided with a series of difficulties that the Transmilenio buses started to have: they were breaking down due to filter plugging. The Bogota mass transportation company blamed biodiesel because the buses had not experienced such fuel problems in the past. It was a strange finding, considering that Bosch, the well-known spare parts company, had been entrusted with analyzing the injector system during the trials and had determined, as an expert in the area, that there was no wear.

Fortunately, Sí 99, the operator of 22% of the fleet,[33] had another fleet with a different route in which it used conventional diesel and, after the relevant tests, the fossil fuel was found to be the root of the problem with the articulated buses.

31 The impact exists. It depends on the numbers of stops and stop times.

32 Resolution 180243 of 2007.

33 During the year of the test, Transmilenio had a fleet of 1,000 buses (now 1,250). In any case, the measurement was not done on the basis of the number of buses but of kilometers. Overall, the life cycle of an articulated bus is 1 million kilometers.

Mechanical check of the injection system in Chevrolet NKR3 vehicles.
Photography: Gutiérrez, R. y Holguín, J. L. (2008).

Indeed, Ecopetrol S.A. was making changes in the sulfur content[34] and had not warned the consumers, on the assumption that they would not be affected.

The test of covering 1 million kilometers in Bogota, at 2,600 meters above sea level, came to an end in 2009. Its success became an important milestone in the history of the biodiesel project, initiated by the Government in 2004 with the support of the oil palm Federation.

Again, Cenipalma, Fedepalma and Ecopetrol S.A. now accompanied by Sí 99, delivered the positive long-term performance results to the ICONTEC technical committee. The automotive industry then suggested that new trials should be conducted on the inter-city highways. Their argument was that highway conditions

34 At present, the sulfur content in diesel is 50 ppm. Back in 2004, when the biodiesel project was implemented in Colombia, that content was 4,000 ppm.

were very different from those in the streets of Bogota where, moreover, the articulated buses are under close control and weekly maintenance. In other words, they claimed that Transmilenio buses were being operated under ideal conditions. The Ministry of Mines and Energy accepted the argument.

The truth is that the automotive sector knew that the law was intended to gradually increase the percentage of biodiesel in the blends up to 10% and they feared that, above 5% – mandatory in Colombia at the time – their vehicles might experience performance problems. However, this time around the sector was eager to participate in the next test.

Advertising campaign promoting the use of biodiesel for cleaner air.
Photography: Gutiérrez, R. and Holguín, J. L. (2008).

Third test: it works well even on "La Línea" highway

Ultimately, the third test was definitely a confirmation that biodiesel-diesel blends performed well on all of the country's roads. It was relevant because all normal vehicles, regardless of their make, are designed for testing at 1,500 meters above sea level, the maximum stress altitude. In Colombia, some highways, such as "La Línea"[35] are well over 3,800 meters above sea level. Hence the concern of the vehicle manufacturers regarding road tests in the country.

So, in 2009, a project to undertake long-term tests using oil palm biodiesel in cargo trucks belonging to Coordinadora Mercantil was put in place, with several

35 Name given to the highway that crosses the Central mountain range, connecting the departments of Tolima and Quindio.

goals in mind: to validate the use of the biofuel in intercity routes using NKR trucks, which represent almost 60% of the diesel automotive fleet in Colombia; to study environmental benefits in greater depth; to assess the effects on the engine using the borescope inspection[36] technique; and to check the performance of the diesel/biodiesel blends following the most stringent protocols of the automotive industry.

Biofuel storage and blend station during the long-term testing with oil palm biodiesel in a fleet of cargo trucks.

The fact that GM Colmotores issued the guarantee for the vehicles in the project, proved to be very important, since it was this car assembly company that had expressed the greatest fear of performance problems and had opposed the increase of the biofuel above 5% in the blends.

36 It consists of checking equipment and structures internally, including such things as tubing, containers, boilers, valves, etc., with the help of a video tester. The inspection allows for observation, and determination of obstructions, internal superficial defects, crust formation, rusting and/or adhesions. The report includes photographs and/or video of the inspection.

However, during the test design phase, GM Colmotores insisted that a maximum of B10 fuel be used, given that the Colombian regulation pointed in that direction. But Cenipalma managed to persuade the industry to go up to B20, and tests were finally run using B5, B10 and B20.

The results of these tests were as robust as the previous ones. So much so that GM Colmotores is now convinced that palm oil-based biofuel works very well in Colombia. All the links in the biodiesel industry chain are satisfied and confident about the benefits of using biodiesel.

The quality standard is built

Prompted by Fedepalma and ICP, the Colombian Technical Standards Institute (ICONTEC) began building the biodiesel quality standard in 2005, based on the European – EN 14214 – and the American – ASTM D6751 – standards. At the same time, Fedepalma and Ecopetrol S.A.-ICP were running tests that ICONTEC would use later as inputs to characterize Colombian biodiesel.

After intense debating in the technical committee,[37] with the participation of about 35 people, each one with their own vested interests depending on the raw material they were advocating for biodiesel production, the Colombian Technical Standard (NTC in Spanish) 5444 was finally made public.

Producers of biodiesel who used animal fats and vegetable oils like castor oil, jatropha and, of course palm oil, were among the parties involved in the debate. However, when Ecopetrol S.A. began to conduct experiments, it was found that not all these products met the internationally accepted technical specifications described in the rules used as references.

Consequently, the job was to create a regulation linked not to a specific raw material, but to the product's final performance. This means that any biodiesel produced or marketed in Colombia must meet 26 quality parameters, regardless of its origin.

To illustrate the strictness of NTC 5444, it is sufficient to say that biodiesel produced from castor oil, meets only 25 of these parameters. For example, its viscosity is very high, so it does not meet the rating for this parameter. Neither do soy or rapeseed biodiesel meet the parameters pertaining to iodine index and oxidation stability.

37 The technical committee is permanent and is made up of the different agents in the industrial chain of liquid fuels, fuel alcohols and biodiesel. ICONTEC coordinates it and acts as its secretariat. At present, the committee is made up of private and public sector representatives.

In contrast, oil palm biodiesel is astonishingly good in meeting the stringent national and international requirements.

Moreover, Colombia is the only country in the world where certification of each biodiesel batch is a requirement. Consequently, all producers deliver their biodiesel with its respective quality certification.

The results helped consolidate the reliability of oil palm biodiesel as fuel in the topographic conditions of Colombia. Photography: Gutiérrez, R. and Holguín, J. L. (2009).

Biodiesel production plants: Another oddyssey

The use of biodiesel-diesel blends in Colombia legally came into force on January 1st, 2008. However, from the moment the oil palm producers became seriously involved with the whole theme, they had been thinking about the technology they would adopt for the design and construction of their biodiesel plants. They had even visited several operations in different countries in 2005: ADM/Connemann, RBE Biodiesel Anlage, and New Natural Energy in Germany; Energea in Austria, and Grupo DHN in Spain. They also attended a conference in Neuss on the operations of EkotecGmbH&Co. KG.

Cenipalma was again there to support investors in their analyses of the technology. They looked into the types of inputs, technical and infrastructure requirements, and into methanol – a flammable product – handling and storage, including the specifications for the storage tanks. At the same time, Fedepalma hired Wolfang Rupilius, an international expert on the subject, to help with the identification of the appropriate technology.

In 2007, the Ministry of Mines and Energy, based on information provided by the Colombian Oil Palm Research Center and by ICP, created the regulations for biodiesel production plants and, in particular, for the quality of their product. It established eleven obligatory parameters for each batch, which means that each batch of biodiesel delivered to the tank trucks has to be certified. Thus, Colombia became the only country in the world where producers are required to maintain the quality of their product permanently. This distinguishing aspect of domestic biodiesel relieves producers of any third-party liability because the certification is a way to assure that any problems that may occur are not attributable to the production stage but to other stages in the supply chain.

When the ministerial regulations came to light, oil palm growers-turned-into-biodiesel producers, panicked: just setting up an adequate laboratory to ensure that their biodiesel met all eleven parameters required by the government would mean an additional million dollars per production plant. However, they knew this would be a distinguishing factor that would result in significant rewards not only in the domestic market but also in foreign markets. Consequently, they started to work on a solution and found that the best idea was to outsource this service. They selected SGS, a laboratory firm that is now providing the service to several plants and awards batch quality certifications after conducting the relevant tests.

Pipeline transport: a showcase for the world

The journey to implement the law started in Cartagena, with the arrival of the first load of 5,000 barrels of biodiesel coming from Oleoflores, a production plant owned by Carlos Murgas Guerrero and the first to operate commercially in Colombia.

The fleet of 25 tanker trucks crossed many narrow unpaved streets and slums to reach the docks at Pasacaballos, where the fuel was loaded onto a barge moored at one of the docks owned by the Transportation Division of Ecopetrol S.A.. From

there it was pumped to the Cartagena refinery tank, prepared in advance to receive the product.

When Ecopetrol S.A. officials started the pumping operation using special positive displacement pumps,[38] they were pumping at maximum pressure but did not realize that the fuel was not reaching the tank at the refinery.

Finally, someone at the refinery asked, "Where on earth is the biodiesel going, if it is not getting here?" After a good laugh, they got down to checking the entire line, fearing a spill. The problem was finally identified at eleven o'clock that night in the form of a dead end in the pipeline, which had not been detected because the monitoring stem was facing downwards instead of upwards.

With the product finally in the tank, they took a number of samples and put them in separate lovely little bottles as a gift for the refinery manager. They were the evidence of the first biodiesel brought for refining on this side of the world. But to their chagrin, when they handed the manager his gift next morning, they found that the bottles were filled with small white crystals that dulled the shining golden biodiesel fluid.

They went into the Internet to start their search for an explanation of this sudden change in the appearance of the biofuel. After a fortnight of unrelenting work they finally found the explanation in the Minnesota Report: It stated that what now filled their storage tank was a substance called "haze" (sterol glycoside).

Naturally, the biofuel which arrived from Oleoflores late in 2007 was not used immediately. It was only released for initial trial transport through the pipeline fifteen days later because that was also the time taken to prepare the first B2 tanks in Cartagena.

In the meantime, the "haze" issue was solved relatively easily because, luckily, the tank used for biodiesel storage was the same as those used for jet fuel, with a design that allows product separation. Two weeks later, the new "ingredient" had already precipitated, allowing the blends to be made.

Transporting biodiesel through the pipeline network was an interesting development that gained international recognition. In fact, had it not been possible to do it that way, the market would not have been sustainable.

38 When pressure is very high, this type of pump opens a valve to empty the product, returning to the barge.

The possibility became a fact when Ecopetrol S.A. learned that such was the system in place in France. The ICP proceeded immediately to find the way to transport the product through the pipeline without affecting the characteristics of the jet fuel.[39] Colombia is the only country on this side of the hemisphere receiving blends in all its pipelines, a showcase experience for the rest of the world.

A troublemaker: haze or sterol glycoside

Sterol glycoside (haze) is a solid that forms at temperatures close to the biodiesel pour point. It depends on factors such as mono-glyceride, water, soap, and sterol glycoside content. At present these are all measured as part of the total contamination parameter.

It occurs in biodiesel regardless of the original raw material, and worsens in the presence of water. It is no secret that the fuel sector in Colombia was accustomed to dealing with certain water levels, particularly in diesel fuel, although for different reasons, including deliberate water addition.

As it happens, unlike the old diesel high in sulfur content, water has deleterious effects on the improved low-sulfur diesel that arrived on the Colombian market in 2010. The situation was such that two water-intolerant products, which nonetheless end up absorbing the water, were coming together in a blend.

The number of consumer complaints due to blends with haze increased. They could not understand the fact that biodiesel leaving the plants in perfect quality conditions was actually becoming altered during transportation or in service station storage tanks, precisely as a result of mishandling.

In an attempt to solve the problem, the different links in the chain, including Exxon Mobil, Chevron and other wholesalers, agreed to develop good practice technical guidelines. These were circulated in 2011 and publicized through numerous conferences attended by nearly 1,400 people. However, compliance with the guidelines is not compulsory at the present time.

In Colombia, the problem of haze has been tackled in the same way as the first time it was identified: by draining and allowing it to precipitate to the bottom of the tanks – the same used for jet fuel storage - making the operation easier.

39 System used for making the pilot test in pipeline transport.

What comes next

Many of the discussions pertaining to the biodiesel law focused on gradual blend increases from B5 in 2008 to B10 in 2010.

"The oil palm trees needed for B20 are already sown", insisted oil palm growers. But vehicle manufacturers refused, and continue to refuse, to issue warranties for their engines if the percentage of biodiesel increased above B10 in blends with fuel for diesel engines.

The automotive industry is dynamic and is required to adapt to new technologies that minimize particulate emissions into the atmosphere. The Colombian Ministry of the Environment has implemented stringent measures that require the renovation of the automotive fleet, considering that the existing one is based on EURO 2 or EPA 2000 technology.

The goal of the environmental authority is that all locally sold vehicles will be EURO 4 by 2013, when all the diesel produced in the country will contain less than 50 ppm of sulfur. Importers argue that such regulation requires particulate matter treatment systems that do not work well with methyl esters. Consequently, it is important to determine the true impact on the system and conduct reliable tests with these types of vehicles.

At the moment, the automotive industry in Colombia consists only of assembly plants and importers. The latter are more reluctant to change given that they lack technical personnel, laboratories or support staff in the event of something going wrong.

Therefore, the discussion is still on going. Besides all political decisions, the technical issues associated with hindering blend increases in certain regions, need to be overcome.

Bigger still is the problem caused by haze, a technological barrier to the increase in blends that must not run the risk of jeopardizing the sustainability of biodiesel in Colombia. Tests are costly and it is not yet clear how the financial burden ought to be spread. Palm growers, Ecopetrol S.A. and some private companies like Sí 99 and GM Colmotores have chipped in heavily and taken their risks. Who else will come on board is yet to be seen.


Photography: Courtesy of Ecodiesel Colombia S.A.

Biodiesel plant: Ecodiesel Colombia S.A.
Location: Barrancabermeja, Santander. Capacity: 115,000 t/year. Inauguration: July 2010.

Chapter 5

Group of titi monkeys in oil palm plantation.
Photography: Pazos, S. (2010).

A commitment to environmental sustainability

Safeguarding the environment is a guiding principle to all our work in support of sustainable development; it is an essential component of poverty eradication and one of the foundations of peace and security.
Kofi Annan

One of the biggest concerns of mankind today is the environmental damage that it has caused to its planet, mainly due to the unreasonable use of fossil fuels (natural gas, coal and petroleum) for energy. These fuels make up close to 90% of the global energy matrix and are responsible for climate change, due to the huge amount of greenhouse gases (GHG) they release.

This adds to the damage caused to land and water ecosystems as a result of oil spills, like the one that occurred in April 2010, when there was a blowout on an oil platform in the Gulf of Mexico. According to one report from Greenpeace,[1] close to 62,000 barrels of crude oil were spilt into the sea, endangering nearly 400 marine species and the wide diversity of migratory birds which fly along that route every year.

It is worth noting that, in certain volumes, GHGs are necessary to maintain balance in the ecosystem; they become harmful when their composition is altered in the atmosphere, for example as a result of industrial activities. Mass consumption of fossil fuels, waste disposal, deforestation, and cattle farming, among other activities, release huge volumes of these gases that trap sun heat and increase the temperature of the earth. For this reason, scientists blame human activity for the unusual frequency and intensity of climate phenomena such as floods, draughts and hurricanes.

1 Greenpeace. 2011. In: Greenpeace Inform. Madrid. Deepwater, one year later.

The transportation sector is under the spotlight because of the significant role it plays in environmental pollution. It contributes 25% of total global emissions, mostly as a result of cargo movements by land and sea. A report from the Organization for Economic Cooperation and Development (OECD) forecasts that, by 2030, GHG emissions from vehicles will increase by 40%. The estimate has created great social concern and underscored the need to find substitutes for fossil fuels.

Nine of the ten warmest years in history have already been recorded in the first decade of this century. Previously the highest temperature registered had been in 1998. The dire consequences of our planet's feverish state are reflected in the 17-centimeter rising of the sea level over the past 100 years as a result of glacier ice melting and subsequent thermal expansion of the oceans. If the trend continues, this figure might increase to 59 centimeters during the 21st century. This is a terrifying threat mainly for coastal communities, swamps, and coral reefs.

Heat waves have also taken human lives. In 2003, for example, they killed more than 20,000 people in Europe. Moreover, they have contributed to the spread of agents that transmit diseases such as malaria, dengue and cholera. Medical institutions have seen climate change-related increases in patient morbidity and mortality. As if this were not bad enough, it is estimated that water shortages will worsen by 2025 due to climate change, affecting close to five billion people in some regions of the world.

All these reasons, plus others of an economic nature, have been more than enough to urge countries into a crusade for developing alternative energies and allocating significant financial resources to research and development. Mankind is increasingly aware of the bill it has to pay as a result of the prevailing consumption levels. To illustrate the severity of the problem, it is enough to say that every year humans take from nature far more than nature can renew, giving rise to the so-called "ecological overdraft", which became evident for the first time in 1986.

The search for solutions has alighted on biofuels, attractive not only because of their low cost when compared to other renewable sources of energy, but also because they contribute to economic progress in the rural areas: biofuels may reduce, to a certain extent, the poverty that prevails in some areas suitable for the introduction or increase in raw material production.

In view of this situation, the world has shown great interest in, amongst other possibilities, biodiesel. Therefore, policies designed to reduce greenhouse gas

emissions, in particular CO_2 emissions, were essential for biodiesel development. Also, incentives granted mainly in industrialized countries have fueled its exponential growth.

The environmental benefits of using this renewable fuel include, for example, its biodegradability (after only 21 days). Consequently, in the event of a spill or accident, it will not contaminate the soil or the surrounding ecosystem. With a flash point above 110 °C, it is not dangerous; it does not contain sulfur so there are no SO_x emissions; because of its lubricant and detergent properties, it is a good additive that helps reduce engine wear and maintain injection systems clean. Moreover, biodiesel reduces soot emissions, produces less CO_2 during combustion and, unlike hydrocarbons, does not contain benzene or other carcinogenic or polluting substances that cause respiratory diseases.

At present, the world uses biodiesel produced mainly from palm oil, rapeseed and soybean. In 2011, the United States beat its own production record, reaching 2.7 million tons, more than twice its 2010 yields; Argentina, an important exporter, sold almost 1.6 million tons in 2011, and the European Community produced 9 million tons that same year. Adding the production of other countries as well, the global figure for biodiesel production in 2011 was 19 million tons, used mainly as a substitute for diesel in transportation.

The report from the International Energy Agency (IEA) *Technology Roadmap: Biofuels for Transport* states that, by 2050, biofuels may account for close to 27% of the total energy source used in the sector; at the present time they account for only 3%. However, the IEA qualifies its statement by saying that pre-requisites for this growth include using efficient production technologies, internationally agreeing to obligatory regulations for sustainable production, and facilitating global cooperation for technology transfer and capacity building.

Biodiesel and the environment

It is important to recognize that the links between biodiesel and the environment go far beyond the emissions it will help reduce when used as a substitute fuel for transportation. Indeed, there are further issues related to energy balance and impact on change in land use and on biodiversity, as well as others. Not surprisingly, this new agribusiness has been challenged by various environmental protection groups because of their concern for the protection of the ecosystem, correctly demanding sustainability of the crops and of the overall production

process. World experts have studied the questions posed by civil society, to such a point that there is now a consensus on the benefits that biofuels can bring to the planet, provided their production is environmentally and socially sustainable.

The initial debate regarding biofuels had to do with its energy balance. In short, the issue was whether the amount of energy required to produce one unit of renewable fuel in relation to the amount of energy that same unit is able to produce is or is not less than that of conventional fuels. Normally, energy balance results differ depending on conditions such as the raw material used for biodiesel production, the geographic location of the plantations, the production process, etcetera. It is precisely due to these conditions that it is not possible to extrapolate the results of energy balances estimated with soy biodiesel from the United States, or oil palm biodiesel from Malaysia to the rest of the world. Each country has its own characteristics, making biofuels different from each other. However, due to financial, technical or political reasons, countries from the North refuse to acknowledge this irrefutable fact, and legislate on the assumption of a non-existent homogeneity.

Sustainable oil plam production is essential for the preservation of the areas under its influence. Photography: Toro, F. (2008).

Energy balance is also used as a technical and economic feasibility index when different biofuels are compared. For this reason, Colombia decided to conduct a study on the energy balance of palm oil biodiesel in Colombia and Brazil. This study was headed by Cenipalma, and its researcher Edgar Yáñez, along with other international researchers. In Colombia, three processing plants and plantations in three different regions were considered. The energy input/output ratio is calculated for the entire biodiesel life cycle, ranging from the energy used in the crop, the energy required for transformation into oil, and the energy required for conversion into fuel. The results for energy input/output ranged between 4.9 and 6 units, which meant that Colombian palm oil gave higher efficiencies than those obtained by other researchers in similar studies conducted in Europe and the United States with soy and rapeseed biodiesel. It also gave higher efficiencies than palm oil from Malaysia or Indonesia.

Another study, also with the participation of Edgar Yáñez, compared the potential for bioenergy production of the main biofuels, and highlighted the fact that palm oil biodiesel produces 58.4 gigajoules per hectare, while soy biodiesel produces up to 25 and sunflower biodiesel up to 36.[2]

In most cases, biodiesel comes from plants or trees, meaning that these raw materials absorb CO_2; when this gas is then released into the atmosphere, it does not contribute to higher emissions because it becomes part of the carbon cycle. However, once the issue of energy balance was solved, a second challenge surfaced regarding the additional emissions that were caused by changes in land use as a result of the demand for renewable energies. This being because land is the primary resource for the production of biodiesel and food.

Use of the land

Land use changes are analyzed from two perspectives: on the one hand, changes associated with direct land use, meaning emissions produced by raw materials when these are grown on land used previously for other purposes; on the other hand, changes resulting from crop displacement from one area to another, affecting forests in particular. Hence the great concern for the impact that growing raw materials for biodiesel might cause on soil quality, agricultural frontiers and biodiversity. In fact, an IEA study revealed in 2004 that 5% substitution of fossil fuels with biofuels would require 20% of the planted area in Europe and 21% of

2 Escobar J. *et al.,* 2009.

the planted area in the United States. Based on supply and demand, this would result in high pressure on land supply and, consequently, displacement of traditional crops to other soils in the same country or to developing countries with land of high agricultural potential.

However, although these changes are of great concern to society, in many discussions with experts the core of the debate is the difficulty arriving at a real, well supported measurement for the GHG generated by these changes. Indeed, there is no scientific evidence for such a measurement and there is still an ongoing debate with the economists regarding the validity of the parameters and hypotheses used for these calculations.

Not surprisingly, there was bad feeling in 2010 when there was a leak, at an international level, of a study requested by the European Commission, on greenhouse gas emissions derived from biofuels. This study was carried out by the International Food Policies Research Institute (IFPRI), and showed that emissions from biofuels are higher than those from fossil fuels when the factor that measures land use changes is put into the equation. The rejection of these findings was not slow to come, in particular because the European Commission itself had made it clear that the factor for land use changes was not considered in the fossil fuel emission estimates. The position of the European Biodiesel Board (EBB) has been clearly opposed to the results of the study, mainly due to the methodological and conceptual flaws identified.

Deforestation, recovery of degraded lands and biomass

When growing crops for biodiesel production implies going into the forests to cut trees and deforest, there is a strong negative impact on the ecosystem. It is not just a matter of loss of biodiversity, but also of disrupted water cycles and land erosion, among other things. This being the case, one could think that the biofuels market, in some cases, promotes conversion of natural areas into crop-growing areas, although it also generates a positive environmental impact when degraded lands, instead of natural forests, are used for this purpose.

According to complaints from different environmental NGOs, oil palm crop expansion in Southeast Asia has come about as a result of high demand for biodiesel. However, it is clear that close to 70% of palm oil production really ends up in food products, although it is also used in cosmetics and detergents. The effects on the forests have occurred in well-known areas of valuable biodiversity,

such as the tropical jungles and rain forests on the island of Borneo, where crops were grown at the expense of wild species such as orangutans and Malayan sun bears, amongst others. Malaysians and Indonesians have come under much criticism because, aside from cutting the forest, they use natural peat deposits, releasing huge amounts of CO_2 into the atmosphere. In Malaysia there are 5 million hectares planted with oil palm and this amount is growing, and the same is true in Indonesia, the number-one producer in the world, with 8 million hectares.

In view of all this, it comes as no surprise that palm biodiesel projects are constantly under the spotlight. There are frequent debates which can become quite heated at times. Those who are against renewable fuel generation projects argue that land should be used for food and not for energy production; they also advocate forest preservation in order to avoid harmful consequences to the environment and negative impacts on food and land prices.

But, where as in Asia there are experiences associated with bad agricultural and environmental practices, in Latin America there are countless examples of exemplary practices. Such is the case of the Brazilian initiative launched by former President Luis Inázio Lula da Silva, in 2010, for the recovery of land degraded by deforestation or cattle farming in the Department of Pará in the Amazon basin. On this subject, the Brazilian President stated:

> With our future oil palm plantations our goal is to recover degraded areas. Not one single tree will be cut in order to plant oil palm.

And about the oil production project to feed the biodiesel market, he said:

> A 'marriage' between environmental protection and job creation…

Curiously enough, Malaysia, Indonesia and Brazil are also the countries that have shown important progress in the use of biomass[3] derived from oil palm and sugarcane crops. Despite multiple criticisms, we cannot forget that organic matter has been an important source of energy since early times. In fact, biomass coming from the residue of trees and agricultural products has been a source of thermal energy for years and currently accounts for more than 15% of world

3 Plants transform the energy of the sun into chemical energy through photosynthesis, and part of that energy remains stored in the form of organic matter, which can be recovered by direct combustion or through transformation into fuel.

energy demand. According to FAO, biomass could also supply one fifth of the electric energy and will account for two fifths of direct fuel use by 2050, mainly in developing countries.

Oil palm agribusiness generates significant volumes of biomass; of the total produced at the processing plant, 53.2% are empty bunches, 32.2% are fiber and 14.6% are shell.[4] All of these have high energy potential for fuel. In most cases, the empty bunches are returned to the plantations for soil conditioning; fiber is used to feed the steam generating system needed for the processing, and the shell is used in part to improve the roads inside the plantation, and in part it is burnt in the boilers. Cenipalma believes that this valuable material, when burnt, may generate up to eight times the energy consumed in the processing.

The complete use of oil palm biomass is a new vision of this agribusiness.
Photography: Toro, F. (2009).

At the moment, a concerted effort is under way to promote its more efficient use. In fact, in 2011, Malaysia showed its strategic interest in this product when it placed this topic at the top of the agenda of its biennial international conference

4 Nutshell.

on oil palm agribusiness. At the same time, the Malaysian Prime Minister, Datur Seri Najib Tun Razak, used the forum to launch the National Biomass Strategy 2020 (NBS 2020), which is expected to create close to 70,000 new jobs.

According to a WWF[5] report, the use of biomass generated from agricultural and forestry products would reduce CO_2 emissions by 1 billion tons per year.

So great is the interest in the opportunities offered by biomass in the world, that the United Nations Organization created the Global Sustainable Biomass Fund, which mainly finances projects in developing countries. The Global Bioenergy Partnership (GBEP) with its objective to "support wider, cost effective, implementation of biomass and biofuels, particularly in developing countries where biomass use prevails," has the role of promoting the transformation of biomass use towards more sustainable and efficient practices.

Sustainable biodiesel

The growing concern for inadequate management and unsustainable practices in relation to biofuel production, and the need to ensure sustainable growth for the sector, led to the creation of the Roundtable on Sustainable Biofuels (RBS). This initiative is a tool to support political and management decisions for evaluating the sustainability problems of biofuel raw materials. Its creation was promoted by the Energy Center of the Swiss Federal Institute of Technology in Lausanne.

The RSB standard consists of a series of regulations and support documents covering the entire supply chain, from raw material production to biofuel supply to consumers, including any negative effects that may arise from biofuel use. The standard encompasses 12 principles designed to become a single worldwide platform to ensure sustainable biofuel production.

In turn, the Inter-American Development Bank (IDB) created a scorecard tool for the evaluation of environmental and social effects. The tool is directed mainly to project designers and implementers as well as to financial institutions and private investors. It was launched precisely in 2008, during the height of the debate on biofuels, and it not only goes hand in hand with the principles and criteria of the RSB but it also compliments them. The World Bank did not fall short. Together

5 World Wildlife Fund, the world's largest independent conservation organization. Its mission is to stop the degradation of the planet's natural environment and to build a future in which human beings may live in harmony with nature.

with the WWF, it created a management framework that focused exclusively on the environment in order to analyze the positive or negative environmental impact of these types of projects.

In fact, several initiatives have unfolded over the last few years in order to approach biofuel environmental and social impacts. Standing out among the new regulatory frameworks are the European Renewable Energy Directive (RED), the United States Low Carbon Fuel Standard and the Renewable Transport Fuel Obligation (RTFO) from England. Among many other voluntary standards and certification programs, it is important to mention the Roundtable for Responsible Soy production (RTRS), the International Sustainability and Carbon Certification, and the Roundtable on Sustainable Palm Oil (RSPO).

One could think that this proliferation of regulations, some of them compulsory and others voluntary, as well as protecting the environment, constitute a non-tariff barrier for trade; more so if it is taken into account that many of them are difficult to comply with for the small and medium agribusiness companies because of their lack of technical and financial resources. In this sense, the role of these standards could be revised to create one single standard that encompasses all the requirements of the existing regulations, thus lowering implementation costs and reducing the confusion among producers who are not clear about which consumer preferences and demands they should focus on.

The restrictions on international trade imposed by these regulations and voluntary certifications become evident when the United States and countries in Europe forbid or exclude, in their biofuel policies, all biofuels that use palm oil as raw material, on the basis of studies of which scientific accuracy has been seriously challenged. This is precisely what happened early in 2012 when the United States Environmental Protection Agency (EPA) stated that palm oil biodiesel does not meet the requirements of the US regulations, which categorize alternative fuels as those that result in at least a 20% reduction in emissions compared to fossil fuels. Based on the oil palm crops in Malaysia and Indonesia, which account for nearly 90% of the world production of palm oil, the agency determined that emission reduction of palm biodiesel is only 17%. It came to this conclusion essentially because it quantified land use change from tropical forest to commercial crop. However, what is striking about the decision is that it does not ban the importation of crude palm oil for biodiesel production or for food production in the United States. So the question is, how legitimate or honest may EPA's interest in environmental protection really be?

Roundtable on Sustainable Palm Oil

The Roundtable on Sustainable Palm Oil (RSPO) sets forth principles and criteria for world production of palm oil, the raw material of choice in Colombian biodiesel production.

It was created in 2004 as a result of the WWF's interest in promoting the sustainable development of the palm agribusiness, and it is now considered a unique cooperation platform designed to increase the use and sustainable production of this oilseed crop. Its main objective is to "promote the growth and use of sustainable palm oil through cooperation within the supply chain and open dialogue with all the stakeholders". Its vision is to "transform palm oil markets". Consequently, it may be considered as the mechanism through which a voluntary certification program can be implemented to ensure availability of oil produced responsibly under the most stringent parameters.

This is an enormously valuable initiative, considering that palm oil contributes at present to one third of the 151 million tons of vegetable oil produced in the world every year. If the same pace is to continue, it is estimated that world demand for palm oil will reach 77 million tons or even more by the middle of the century, depending on the evolution of biodiesel over the next few years.

Palm oil is the most commonly traded oil in the world, despite the criticisms by NGOs throughout its history. In the 1980s, the attacks focused on alleged human health issues. Once this discussion was overcome, and it was demonstrated that the benefits of palm oil are greater than those of its peers that contain "trans" fats[6] when hydrogenating them, opponents then launched a new argument, this time focusing on its sustainable production. Curiously enough, this controversy has not been expanded to other vegetable oil crops. It is worth noting that although the discussion on the alleged harmful effects of palm oil on human health began in the United States (main producer of soybean oil), the environmental debate surfaced in the European market – the largest consumer of biodiesel, mainly rapeseed biodiesel.

The pressure and force that went into the claims from NGOs such as Greenpeace jeopardized the sales of food products offered by powerful multinational companies,

6 They are unsaturated fatty acids resulting from partial hydrogenation, a proccess designed to solidify vegetables oils in order to produce margarine, fried commercial products, biscuits, etc. The intake of these trans fats increases the risk of coronary artery disease.

main buyers of palm oil in the word. In an attempt to hold on to their market shares, companies like Cargill, Unilever, BodyShop, Marks & Spencer, Mars, Co-op, Tesco, Asda, Nestlé, Procter & Gamble, McDonalds and others, committed to using only certified sustainable palm oil starting in 2015.

For this reason, the RSPO world initiative, together with its Principles and Criteria (P&C), is of great value, as it is based on the philosophy of the three Ps (People, Planet, Profits). According to this philosophy, the people, the planet and the profits are the pillars of sustainable development. Therefore, in order to preserve palm oil integrity, all of the players in the chain, from producers to consumers, must do so with a transparency that allows for traceability. This is achieved through the application of P&C to sustainable palm oil production, and through the use of support and guidance indicators.

Principles

The principles listed below are the world guidelines for the production of sustainable palm oil. They are considered the most stringent guidelines in the world related to the development of sustainable agriculture, hence their adoption by other crops.

They also encompass criteria that are reinforced by indicators that arise from the national interpretation that each country does.

1. Commitment to transparency.
2. Compliance with applicable law and regulations.
3. Commitment to long-term economic and financial viability.
4. Use of appropriate best practices by growers and millers.
5. Environmental responsibility and conservation of natural resources and biodiversity.
6. Responsible consideration of employees and of individual and communities affected by growers and mills.
7. Responsible development of new plantings.
8. Commitment to continuous improvement in keys areas of activities.

Palm oil producers have worked exceedingly hard in this respect. In 2011, 10% of the world's production was certified, encompassing close to 1.2 million hectares

in the process. However, the same type of commitment for acquiring these certified tons has not materialized from the large scale buyers. That is to say that despite the technical and economic efforts by the agricultural sector, downstream in the chain the actual demand for this certified oil is no more than 50% of the total production. To justify its sluggishness in absorbing the certified oil, the industry blames economic factors such as the market premium or higher prices commanded by these tons, as well as technical factors like difficult storage logistics.

However, RSPO has continued with its efforts; in September 2010, it applied to the European Commission for formal recognition of the voluntary system developed to comply with the EU-RED requirements (Directive 2009/28/EC) for the promotion of energy derived from renewable resources. The voluntary scheme developed by RSPO is called "Additional Guidelines" because it adds to the generic standards. As far as compliance with EU-RED is concerned, it requires the following:

- Evidence that plantations and mills were operational before 2008.
- Origin of certified oil purchases and evidence that the plantations from which they came were already in operation before 2008.
- Evidence of methane capture in oxidation lagoons.

The additional guidelines were approved by the Dutch Authority on emissions, which extended the enforcement date until July 2012.

Colombian oil palm is environmentally friendly

The decision of the Colombian palm agribusiness to conduct its work in an environmentally friendly manner led Fedepalma not only to join RSPO, where it even acted as one of their vice-presidents representing the countries of Latin America, Africa and Oceania between 2004 and 2006, but also to promote the implementation of the Principles and Criteria throughout Colombia. This process of the local adaption of the RSPO guidelines received technical support from environmental organizations such as the Alexander von Humboldt Institute for Biological Resources Research (IAvH) and WWF. In November 2010, after two years of joint work, the RSPO Board of Directors approved the adapted version of the Principles and Criteria for Colombia.

In response to one of the requirements in the "Additional Guidelines" for complying with the EU-RED, mentioned above, Fedepalma and Cenipalma led the first Umbrella Project approved by the United Nations within the framework of clean development mechanisms (CDM) for methane gas capture and reduction in residual waters. The objective was to lessen the emissions of GEI to the atmosphere. Besides the attractive goal of developing clean production, one of the most important aims of this project from the very beginning was to achieve differentiation in the international market from their Malaysian peers, whose production practices had been widely criticized.

Corocoras, bright-colored birds typical of the oil palm ecosystem. Photography: Toro, F. (2007).

The initial inspiration for the CDM project came from the experience at Palmeiras S.A., a company in the Colombian region of Tumaco, which had come up with the idea of covering its anaerobic lagoon, and so became a pioneer in the transformation of methane gas into biogas for energy co-generation in the oil palm sector. Between 2002 and 2008, this company co-generated up to 600 kW/hour. However, it had to stop the operation of its plant in 2008 because of

the damaging impact caused by bud rot disease on its plantation.[7] The methane capture and co-generation operation was so successful, that the company received visitors from Central America and even from large Malaysian producers who were interested in learning more about the practice, apparently the only one at the time in the world.

Starting in 2002 and until the project was approved by the United Nations in 2009, Fedepalma and Cenipalma, driven by the idea of multiplying successful experiences throughout the sector, became top players in focusing efforts, centralizing actions and executing the tasks needed to ensure that 32 of the 52 processing plants started to move along the clean development path in a coordinated fashion. The potential was to target nearly 760,000 emission reduction certificates (ERC) per year over a 21-year period. At present, a few extracting companies are installing the monitoring systems and it is expected that they will start trading carbon bonds on the voluntary market by 2013.

In terms of co-generation, there is also a huge potential in the Colombian oil palm sector for energy production using the biomass left over from the fruit processing operation. The Federation is working on a program to drive co-generation, as it estimates that the sector can generate between 150 and 200 available megawatts from renewable energy coming from biogas and biomass.

Intent on making sure that the environment becomes part of the oil palm agribusiness in Colombia, Fedepalma added a new project to its efforts of the past decade. This project was approved in April 2012, also by the United Nations, through its Global Environmental Fund (GEF). The aim of the project is to strengthen biodiversity in oil palm agro ecosystems through characterization processes, maintenance of protected areas, biological corridors, and environmental services. This initiative will be developed jointly with Cenipalma, the Alexander von Humboldt Institute for Biological Resources Research and WWF over a five-year period.

Worth mentioning also is the study commissioned by Fedepalma in 2004, *"Desempeño ambiental del sector palmero en Colombia, evaluación y perspectivas*" (*Environmental performance of the Colombian oil palm industry: evaluation and prospects).* Already, at that time, there was an interest in assessing the situation of the crop in Colombia in order to respond proactively to the criticisms arising around the world. This was even more important considering that Colombia is well known as one of the most mega-diverse environments in the world. The

7 For more information, see Chapter 3 of this book.

results of the study showed how the oil palm industry honors its commitments under the 1997 Clean Production Convention, confirming that the oil palm companies attach the highest importance to environmental management and invest huge resources and efforts in reducing, alleviating and controlling possible environmental impacts derived from their activity.

Preserving oil palm ecosystems such as morichales is important for environmental sustainability. Photography: López, A. M .(2011).

Over the past decade, the sector has also been a leader and participant in conventions and agreements designed to analyze oil palm biodiesel's carbon footprint and determine whether this fuel is the best environmental option compared to other fuels. One of the projects under these agreements aims to identify and characterize areas that are suitable for growing oil palm in Colombia, in order to incorporate environmental criteria into the process. It is a joint project with IDEAM, and has the support of the Agustin Codazzi Geographic Institute (IGAC), the Ministry of

Housing, Environment and Territorial Development, the Alexander von Humboldt Institute, WWF, Cenipalma and Fedepalma.

Initially, two Colombian geographic maps were analyzed: one of oil palm crops, and the other of high-value ecosystems that should not be intervened with at all. The analysis did not show evidence of encroachment of the oil palm activity into these ecosystems. If the same analyses were to be conducted in Southeast Asia, the maps would certainly overlap.

However, this does not mean that the expansion of oil palm areas does not create environmental risks. It may take over different areas from those previously transformed (rice growing areas or cattle raising areas) or those of degraded lands. For that reason, the aim was to prepare land suitability maps in order to determine which of them could be used for planned oil palm expansion, in order to meet the growing demand for biodiesel. In this sense, the project does not only define the methodology for incorporating environmental criteria (ecosystems, biodiversity conservation, water protection, soils and lands, restrictions and potential use) when it comes to determining the areas where oil palm will be grown; it also builds the land suitability map for oil palm production at a 1:100,000 scale in analog and digital formats and prioritizes the areas for subsequent zoning. At the same time it analyzed changes in coverage of oil palm crops between 2000-2003 and 2004-2007.

In turn, in 2008, the Alexander von Humboldt Institute and the Ministry of Housing, Environment and Territorial Development conducted the *strategic environmental evaluation of biofuel policies, plans and programs in Colombia, with emphasis on biodiversity*. They wanted to assess cumulative, synergistic and indirect environmental effects – with special emphasis on biodiversity – of biofuel development policies, plans and programs. They also sought to formulate comprehensive strategies and guidelines for environmental sustainability for the public national biofuel policy.[8] They did so with emphasis on priority raw materials for ethanol and biodiesel production. So, based on a set of criteria such as the importance of food safety, native biodiversity, family or small-farm production, relationship with agribusiness, actual expansion of planted areas, and importance in the domestic market, amongst others, they identified the agricultural sub-sectors with the greatest potential for biofuel production: sugar, oil palm, brown sugar (*panela)*

8 "Strategic environmental assessment of biofuel policies, plans and programs in Colombia, with emphasis on biodiversity". IAvH Report, 2008.

and cassava. Of these, only one was raw material for biodiesel and, although jatropha was also considered, it was shown that its potential as an energy crop in Colombia, at least in the medium term, was debatable.

The recommendations from the study were added to the policy tools designed to ensure sustainable fuel production. Among these tools, one that should also be mentioned is the Guideline for the Sustainability of the Biofuel Chain in Colombia, ICONTEC END 49. Its objectives are to "*establish the environmental, social and economic sustainability principles, criteria and recommendations that need to be met in the biomass production and processing stages of the biofuel chain*". It was based on the RSPO Principles and Criteria, and on the identification and characterization of suitable areas for growing oil palm in Colombia, which has already been mentioned.

In this way, many and varied efforts have been made in Colombia to promote and secure a sustainable supply not only of palm biodiesel but also of its raw material. This without any doubt contributes to the creation of a marked distinction between Colombian palm oil and its products and international palm oil and the products that contain it.

The life cycle of oil palm biodiesel

EMPA, the top European agency in environmental impact assessment, conducted a national study on the "Life cycle assessment of the biofuel production chain in Colombia" and found that Colombian oil palm biodiesel contributes to greater GHG emission reduction than that reported for other countries such as Malaysia and Indonesia. In fact, it surpasses the requirements established by the European Union (35%) and those proposed by EPA (20%).

GHG reductions for palm biodiesel produced in Colombia are greater than 83% compared with fossil diesel, and they could be higher than 108% if methane capture is implemented in wastewater treatment systems. In contrast, the percent reduction for rapeseed biodiesel is 15, while it is 44 for US soy biodiesel, and 35 for Malaysian oil palm and soy biodiesel.[9]

The study also showed, based on historical land use, that oil palm crops in Colombia had mainly replaced grasslands and old oil palm plantations. In addition, it identified 1,053,000 hectares as highly suitable and 2,948,000 as moderately

9 Fedebiocombustibles, 2011.

suitable for oil palm crop expansion. Not included in these areas are protected or farming lands or those categorized as unsuitable on the basis of soil and climatic conditions, or areas with less than 40% reduction of greenhouse gases, or critical biodiversity areas.

These results point to a clear difference between the domestic oil palm crop and biodiesel industry and its competitors, and without doubt show the sector's commitment to the environment by using agronomic and industrial practices with low environmental impact such as not planting in tropical forests, protecting water sources, using cover crops and implementing integrated pest management, amongst other things.

The strength of these studies ought to open up the discussion about the environmental friendliness of Colombian oil palm, so that it will be accepted by the most demanding international consumers, truly committed to the health of the planet. In Colombia, there are not orangutans which oil palm plantations are endangering or taking away wildlife habitats considered critical for the survival of future generations.

Countries like the United States are clearly ill advised when they make generalizations about vegetable oil production and, based on their own economic interests impose technical barriers, like those already mentioned, for the entry of biofuels into their markets. However, these barriers are non-existent when it comes to the palm oil that is used in their own food industries, and hence the questionable authenticity of their concern for primary forests and biodiversity in Asian countries.

Meanwhile, in 2012, the Obama administration approved 41 million dollars for 13 projects related to the production of more efficient biofuels and improvement of raw materials through innovation in a sector considered critical for the United States. Brazil, in turn, has announced a 13 billion dollar investment for its biodiesel industry. In contrast, Colombia lacks political clarity about the future of this new industry.

Photography: Courtesy of Oleoflores.

Oleoflores S.A. biodiesel plant.
Location: Codazzi, Cesar. Capacity: 70,000 t/year. Inauguration: November, 2007

Chapter 6

Oil palm provides social stability and peace in the rural areas.
Photography: Toro, F. (2012).

Oil palm agro energy: a profitable social business

It isn't enough to talk about peace.
One must believe in it.
And it isn't enough to believe in it.
One must work at it.
Eleanor Roosevelt

Either we all march together towards peace,
or we will never find it.
Benjamin Franklin

The wisdom of the peasants summarized in just a few words for the newspaper The New York Times shows what oil palm means today for many communities in Colombia: "…An interesting alternative for coca crop substitution"[1] and, why not say it, an option for a stable, legal income.

Such was the statement by Misael Monsalve in an interview with the prestigious newspaper. Only five years before, he had been forced to plant coca together with other neighbors in Tibu. The coercion came from Farc, a narco-terrorist group that had maintained control of the Catatumbo region until that time. The democratic security policy of the Uribe administration made it possible for the military forces to recover control over the national territory and, with it, the destruction of illegal crops and their replacement with oil palm that serves as raw material for biodiesel production, among other things.

Oil palm was first mentioned in the government plans of President Andrés Pastrana Arango together with other potential substitute crops such as cocoa, coffee and forestry species. This encouraged smallholders to think about substituting coca crops with this energy crop, considered the most attractive because of its perennial nature and a life cycle of more than 25 years.

1 Biofuels Push Becomes Weapon in Colombia's War on Narco-Traffickers. Nathaniel Gronewold. The New York Times, May 2011.

Substitution was made possible by *Plan Colombia,*[2] created primarily to fight illegal drug trafficking and organized crime, as well as to provide the most vulnerable populations with a means to find different production alternatives. Since 2001, the United States Agency for International Development (USAID), through the Midas program, has invested significant resources in 24 agreements, which have allotted funds to 10 departments and 57 municipalities. The results of this support can be seen in the 51,835 hectares that have been planted, benefitting 3,682 families and creating 24,038 jobs.[3]

With the resources, and the enthusiastic support from large oil palm producers, business operations between them and smallholders gradually became a reality.

The strategic alliances are undeniable proof of the desire and the will of the oil palm sector to act openly and favor inclusion and democratization so that smallholders may also benefit from the multiple opportunities offered by this crop. In all, 83 alliances were created, allowing 4,586 smallholders to join the activity with 33,437 hectares planted between 1998 and 2005, an area that grew to 52,427 hectares in 2006. By 2011, strategic alliances accounted for a quarter of the planted area at a national level, involving 7,000 smallholders.

Seeing this reality and the impetus surrounding oil palm during the initial years of this century, it appeared that it was the most suitable crop to help overcome the conditions of underdevelopment that still burden this country. Also, strategic alliances seemed to herald the development of businesses for smallholders, direct beneficiaries of this productive strategy, as has been the case in Malaysia, where this scheme has led to substantial development.

Indeed, in just about twenty years, the country went from being in a state of profound crisis in rural development to becoming a successful nation on the international playing field. The formula for its success was basically the decision to unite collectively around oil palm and rubber, and provide the necessary means to turn them into the driving forces of the economy.

Our country has the agro ecological conditions to follow suit. However, that is not enough because, more importantly, Colombia as a nation must provide its people,

2 This program began operations in 1999.

3 http://www.elheraldo.co/noticias/agropecuaria/las-alianzas-productivas-palmeras-nuevos-empresarios-66859

farmers, investors, entrepreneurs, and citizens in general, with favorable conditions for development.

It needs to be acknowledged, though, that the mere fact of producing on Colombian soil implies a high cost, due to elevated interest rates, violence in the rural areas, inadequate infrastructure for transporting the products, and a host of other bitter foes for the national competitiveness of oil palm. In fact, our competitiveness is far below that of Malaysia and Indonesia, which are able to produce their palm oil at a much cheaper cost.

As far as rural violence is concerned, a World Bank report approaches the issue from three perspectives: political, economic and social. Political violence is particularly evident in the rural areas, involving political members, illegal armed groups and drug trafficking. They are all parties in a war for the control of the land, a war that makes the farmers homeless victims who happen to live where it is waged and who are forced to flee, leaving behind homes and belongings. The second aspect is directly related to poverty and the adoption of illegitimate means to reach the proposed goals; it feeds on the difficulty of making sufficient income to cover basic needs, affecting the quality of life and the economic stability of the victims. Finally, social violence refers to exclusive actions that bar access to social development. Social exclusion may occur at any stage in the production, distribution or exchange of goods, as well as in participatory stages, in health or in education.

Consequently, violence is a phenomenon caused by multiple factors that can only be corrected when society allows for the inclusion of all people in its different areas. This approach contributes to the so-called "sustainable rural development" which has the primary objective of reducing poverty by means of greater economic and social participation of the rural communities, under a broader perspective that transcends agricultural development.

Oil palm as a means of social inclusion

It is no secret that agriculture continues to be a fundamental component of sustainable development and poverty reduction. It is estimated that three quarters of agricultural production is used as inputs for other industries; this points to its significant multiplier effect as a source of wellbeing, given the tight connection between agriculture and other sectors.

The repositioning of agriculture globally in the past few years has, therefore, been driven to a large extent by its new role as a source of renewable energy. In view of this, the reality of the interdependence between renewable energy and the rest of the global economy can be seen. The primary role of agriculture as a food supplier also places it in the limelight at a time when food safety is threatened by the growth of the world population and its increasing pressure on natural resources.

Colombia and other developing countries recognize that agriculture, and certain crops in particular, play a stabilizing role in rural sustenance, even more so considering that three out of every four poor people live in the rural areas. Hence the importance of thinking beyond the traditional system of individual business production and creating inroads towards "inclusive" development and economic growth models that generate value and benefits for the population as a whole.

Crops, such as oil palm, pave the way for the implementation of this mutually beneficial model, since private businesses, as representatives in the chain, may incorporate a group of small or medium producers in such a way that both parties benefit and a contribution is made to the quality of life of the poorest communities.

This explains why oil palm has gained popularity over the past few years, especially since 2002 when, under the aegis of President Álvaro Uribe Vélez, its fame reached new heights and became the subject of discussion among all social groups. Also called the "queen of energy crops", it was the rising star of the early 2000s, sought out by all local governors who wanted it to help with their development plans; by national and international investors eager to invest their money in a profitable business; by candidates to various government positions who wanted a hot topic for their speeches, etcetera.

Benchmarking for the rural sector

During a visit to Colombia in June 2005 from the former Malaysian Prime Minister Mr. Tun Mahatir Bin Mohamad, the President, Álvaro Uribe Vélez proposed the creation of a bilateral business commission to strengthen the economic relations and the bonds of friendship between the two nations. After all, they had many things in common, including the interest in developing the rural areas, given that the Asian country was able to fully overcome its difficult times when illegal armed groups also subverted public order and peace in its countryside. To the invitation, the former Malaysian minister replied:

> If there is an experience in Malaysia that may be of use to you, you will find in us an open book. We can tell you all about the things we did, including our success with oil palm and rubber.[4]

Indeed, in 1961 Malaysia developed an agricultural model supported by oil palm and rubber, which essentially sought to resettle the landless poor. The scheme was promoted by the Federal Land Development Authority (Felda) together with the Federal Land Consolidation and Rehabilitation Authority (Felcra), with the view of developing settlements on unused public land, where oil palm was then largely grown.

This scheme, also known as "pro-poor", did not only provide land, housing and long-term loans for planting, but in addition supplied technical assistance, education and health to the families. It also built housing complexes, where in some cases it gave accommodation to people doing non-farming work in the rural areas.

By 2009, the Felda model had resulted in 720,000 hectares planted and close to 113,000 families relocated and working.

Felda has become the clear expression of the commitment of the Malaysian government to improve the living conditions of the rural population. Not surprisingly, it is recognized today as the most successful public land development agency in the world. In fact, in a visit to Kuala Lumpur in 2008, the prestigious economist Jeffrey Sachs stated, "Felda's story continues to be a manual for the best practices for poverty eradication". Thirty to forty per cent of the total area planted in oil palm in Malaysia belongs to smallholders working under Felda or some other scheme, such as that of organization around a private plantation or working as small independent producers.

The concept has been criticized on the grounds that it is a very costly means to reduce poverty, but its advocates argue that it has clearly been effective. In fact, improvement in living conditions in the rural areas has been attributed to the developmental plans promoted by Felda. The three most recent Malaysian Plans report that the incidence of poverty dropped from 7.5% in 1999, to 5.1% in 2002, and down to 3.8% in 2009.

In any case, there is significant opposition to the Malaysian model given that a high percentage of oil palm plantations are also responsible for deforestation

4 Presidente Uribe propone Comisión empresarial de Colombia y Malasia. July 2005. http://www.presidencia.gov.co/prensa_new/sne/2005/julio/08212005.htm

in a country with 32 million hectares, 15% of which are planted in oil palm and 61% of which are forests. Added to this are the complaints filed by the *Sarawak* indigenous people, amongst others, who have been dispossessed of their traditional lands.

As far as Indonesia is concerned, despite huge and bitter criticism against its environmental management, it is impossible to deny that the top oil palm producer in the world is using oil palm to drive social development in the rural areas.

The Indonesian agricultural sector contributes to 14% of the country's GDP. In 2008, it employed 41% of the total population, and supplied two thirds of the rural family income through its agricultural activities.

In the late 1970s, in an effort to promote rural development and settle poor landless people from Java, Bali and Madura, the government propelled the implementation of a model based on oil palm plantations in regions such as Sumatra and Kalimantan. This "nucleus-plasma" farm model, which was part of the "Transmigration" government program, contributed, with its various modalities, to the development of nearly 900,000 hectares of oil palm up until 2001.

By the end of the first decade of the new century, 41% of the oil palm plantations were in the hands of smallholders, and by the end of 2008 they were already producing 6 of the overall 18 million tons of oil. At this time, close to 6 million people in the country were earning a decent living through agribusiness.

Notwithstanding, there are still criticisms from the international community concerning oil palm activity in Indonesia, because its expansion has occurred unsustainably at the expense of the ecosystem and biodiversity. The great concern shown by environmentalist and social groups due to the high levels of deforestation, CO_2 emissions and lost biodiversity, raises important questions about social development versus environmental protection.

The problem is now one of ethics, and has to be dealt with by the developing countries which have a large part of the jungle and forest reserves of the planet. The task is by no means easy. It is about distinguishing and balancing what development means to the world today in terms of the survival and advancement of population groups, and the preservation of the planet's ecosystems. The developing countries are in this position because they entered the race late at a time when the United States and European countries had already overcome their development problems without having had to put up with modern day judgments in relation to the change in land use.

But Indonesia is also under attack for other reasons. Some NGOs such as Friends of the Earth, SawitWatch and LifeMosaic have accused national companies of using violent practices to dispossess indigenous communities of their native land. These NGOs claim that, attracted by the profitable biofuel business, land and natural resources are being privatized at a large scale. According to SawitWatch, in 2008 there were 513 disputes between communities and companies. More recently, disputes relating to ownership rights revolve around levels of compensation and unfulfilled promises.

Strategic alliances in Colombia: driving force for peace

The oil palm Federation was aware of these experiences. Fedepalma, always intent on making sure that the agribusiness it represents is a source of wealth and social stability, had been watching and analyzing the models and frameworks that were succeeding in the palm oil producing countries in Asia. It remained on top of all developments, promoting trips so that growers could be first-hand witnesses, as well as organizing meetings and discussions to share information and exchange ideas and views.

In the words of Jens Mesa Dishington, Executive President of the Federation:[5]

> Productive alliances played the dual role of generating economies of scale and tackling the social and political crisis in the country. They contributed to enhance productivity and improve the social environment in the regions. Therefore many people were willing to take part in the project. (…) They would accomplish several objectives: (a) To grow through the creation of economies of scale, and to improve competitiveness at the same time; (b) to address violence with the help of a broader social base and more people willing to fight for oil palm in the regions; and (c) to build new businesses and an entrepreneurial spirit that would drive economic and social development in oil palm growing areas.

As if by chance, at the same time the board of the Federation was discussing options - in Mesa Dishington's own words - to "untie the knot of violence by looking for agreements between business owners, small or medium holders and the government in order to create production centers capable of using economies of scale in oil palm growing areas",[6] the then President Andrés Pastrana Arango

5 Mesa, Jens. 2009.
6 Ibidem, p. 72

At present there are 106 productive alliances in Colombiaon 60,000 hectares planted under this model. Photography: Toro, F. (2012).

appointed Carlos Murgas Guerrero[7] to the position of Minister of Agriculture. Murgas had participated in the travel missions promoted by Fedepalma and in the discussions on a model that could have a positive social impact in the oil palm growing areas.

Murgas Guerrero was among those who believed that the Malaysian model, explained by Mahatir[8] as a long-term policy, could be "colombianized". So this is

7 Carlos Murgas Guerrero was the Minister of Agriculture between 1998 and 1999.

8 Tun Mahatir Bin Mohamad, Malaysian Prime Minister, remained in power for 22 years, until 2003.

what he set out to accomplish, incorporating along the way some of the lessons already learnt from international experiences.

President Pastrana defined the alliances scheme proposed by his minister as a new regulatory framework that could be used as a tool to facilitate the transition from social conflict to peace.

However, as mentioned previously, it was really during the first five years of the 21st century that the model gained momentum, driven by the government's promise that biodiesel would absorb the surpluses from domestic production which were going to the international markets at the time. Consequently, the oil palm sector was able to formalize a win-win relationship with the communities in its areas of influence.

Indeed, oil palm agribusiness wins because companies expand the use of their installed capacity, have access to financial incentives granted by the State, develop new lines of business and, ultimately, contribute to the creation of an environment of safety and security in their regional socioeconomic settings. On the other hand, smallholders win because they receive higher incomes, expand their job opportunities, build credit records with the financial sector in order to have access to future lending, and start on the road to capital accrual that translates into equity consolidation. Moreover, their organizations become stronger as a result of the greater self-esteem of the small oil palm businesses, providing them with an undeniable ability to negotiate with the larger oil palm companies.

There have been close to 110 strategic alliances with smallholders over the past decade. Some of these smallholders have been on national and international media bearing witness to the positive results that oil palm has brought to their lives.

Besides the interview granted by Misael Monsalve to The New York Times, it is worth mentioning that of Edilberto Perez by the magazine *Semana*. His testimonial in May 2012 led the reporter from the Colombian magazine to write "… of the war between paramilitaries and guerrillas in Maria La Baja (Bolivar) only bad memories remain. This is the generalized opinion of farmers who now grow a plant that has changed their lives in little more than six years". And he added:

> The boom in Maria La Baja is reflected in Edilberto Perez's smile. He could not have paid for the expensive orthodontic work if oil palm had not arrived in the region, rescuing from extreme poverty nearly one thousand farmers, who had risked sowing this crop.[9]

9 Samuel Salinas Ortegon. 2012. *El aceite que resucitó a Maria La Baja*. Revista Semana. In: www.semana.com (accessed on May 14, 2012).

There are hundreds of other cases like those of Misael and Edilberto. On average, given high international prices and good productive performance, the current income of a smallholder who owns 10 hectares planted with oil palm, is 1,500 dollars per month. This has improved their quality of life in ways they had never even dreamed of. In Colombia, this figure is relatively high, particularly in rural areas traditionally marginalized because of poverty, violence and government neglect.

As for workers and jobs on the plantations, the oil palm sector is also faring well. It is labor-intensive, to such a point that 40% of production costs are labor-related.

It is estimated that by the end of 2012, oil palm agribusiness will have created close to 50,000 direct and 75,000 indirect jobs with good levels of income. It is sufficient to say that while the wages of an oil palm worker in Indonesia range between 4 and 5 dollars and in Malaysia between 7 and 9, in Colombia figures range between 22 and 24 dollars. This is irrefutable evidence of the fact that, with good salaries, the social value of Colombian oil palm is far greater than that of its competitors.

There is no doubt that these testimonials from smallholders refuted the arguments of those who wanted, at some point, to blame the crop for evils that would happen in the various regions where the agro energy crop was established. In fact, oil palm became the battle horse of those who wanted to challenge government policies designed to promote the crop as part of the energy and social strategy of the Uribe administration, disregarding the fact that it may be a source of progress within reach of every Colombian.

It must not be forgotten, of course, that there are always unscrupulous people who want to take advantage of government incentives, in the midst of the boom, in order to take land from certain populations at gunpoint. There is one particular case that happened in Uraba (Choco) in territories belonging to afro communities in the basins of the Jiguamiando and Curvarado rivers. These people were victims of dispossession and mass killings, their lands were taken by force and, because of an absent State, they also had to deal with the presence of paramilitaries and drug dealers who developed oil palm projects on 3,800 hectares – almost 1% of the total planted area in Colombia – which eventually failed.

For those who have no knowledge about the nature of the conflict in Colombia, it is difficult to establish the distinction between illegal groups that use farming activities as a means to gain control of the territory, and the traditional growers who have lived off the soil honestly under conditions of total absence of a State, that proved to be unable to safeguard their lives and interests.

40% of the costs of production of the agribusiness are associated with well-paid labor, giving a greater social value to oil palm. Photography: Toro, F. (2012).

With their crops, the illegal groups also brought violence to an activity undertaken by thousands of people for more than fifty years: large-, medium- and smallholders, hardworking, honest people who have had to deal with the everyday reality of a country immersed in violence. These farmers are stigmatized and accused due to the abuses of others who have nothing to do with the oil palm agribusiness.

Fedepalma has done its share in defending the trade from these attacks. The Federation has no responsibility over what happened in Choco. The responsibility is of outlaws, "… criminals who wish to consolidate their tainted wealth by ousting communities and taking their land by force…"[10]

But this has nothing to do with oil palm, a name which goes hand in hand with the traditional business class. With its globalized vision and high social responsibility, oil palm has brought wellbeing and progress to the regions where it grows.

On the other hand, there are those who criticize strategic alliances, arguing that anchor companies exploit their partners with their long-term agreements for fruit purchases, even though they guarantee that they will absorb the harvest at market prices at the time of purchase. They also claim that smallholders are limited in their ability to offer their fruit to the existing local market because they are tied to a single supplier. The enemies of the model argue that it is not clear to what extent it has been developed for the benefit of smallholders or rather for the benefit of processing and refining companies that can lower their costs.

In this respect, it is important to highlight that as a Federation, Fedepalma has fostered transparency in relation to sectorial information, favoring more equitable relationships among the various performers in the chain.

Overall, there is strong evidence in Colombia of successful strategic alliances in regions that used to be among the most violent in the country such as Maria La Baja, in the foothills of the Montes de Maria system, the Catatumbo area, Puerto Wilches, southern Bolivar (San Pablo) and Tumaco, all of them under crossfire from guerrillas, drug dealers and paramilitaries.

The Maria La Baja experience

The crisis of seasonal crops that came about as a result of economic aperture[11] and violence, left smallholders immersed in debt. Lacking a sound organization,

10 Public statement from Fedepalma in response to the illegal developments in Uraba (Choco).
11 For more information, see Chapter 1.

they found themselves in a position where they could no longer receive loans, and ended up bankrupt.

Early in 2000, Maria La Baja (Bolivar) was one such impoverished, depressed and despairing area. But then the strategic alliances scheme came into being. It was tested at first with five small landowners who joined pilot projects with people from the region. They accepted the invitation from the Governor of Bolivar and former Minister Carlos Murgas Guerrero to partner with Hacienda Las Flores, the company that would not only finance the seeds, the technical assistance and the fertilizers, but would also purchase the fruit through a 20-year agreement.

Ramos Pedroza, a father of twelve, was one of the first farmers involved in the project. He decided to take the risk with the new crop after bitter experiences planting rice. In his own words, the crop scheme is like a family microenterprise because he divides his own land and the new land he buys among his children, with whom he makes contracts, in order to get them involved in the business and so that they develop a sense of ownership.[12]

Another beneficiary of the project was Juana Ramírez, a symbol of the important role women play in the oil palm business. With her leadership, she managed to get a group of smallholders to plant 536 hectares. About her experience she said: "Whoever does not recognize that Maria La Baja and its farmers have changed is either blind or does not want to tell the truth, because this is truly spectacular".[13] She was one of the first women who joined the process and participated throughout, helping create awareness about the benefits of the crop.

Medardo Mosquera, in turn, has 5 hectares with Asopalma One and 1.5 hectares with Asopalma Two. In an interview with Fedepalma he stated: "I am happy with the project because it has created jobs in Maria La Baja and has brought development through strategic alliances with our other fellow farmers".

The Maria La Baja mill was inaugurated in 2007 under the aegis of Promotora Hacienda Las Flores and a group of smallholders who own 49% of it. The idea of this inclusive agribusiness project was built with the need to consolidate the existing alliances, guarantee the quality of the fruit, inspire a sense of ownership, and improve socioeconomic levels in the region. The participants include 550 families whose ownership is based on shares directly and proportionally related to

12 http://www.businesscol.com/noticias/fullnews.php?id=4026
13 http://www.businesscol.com/noticias/fullnews.php?id=4026

the amount of hectares of land they have. This industrial plant today processes 30 tons of fresh fruit bunches per hour and it is supplied from La Mojana, Palo Alto, La Doctrina, Tibu and Maria La Baja, among other neighboring municipalities.

At present, the Maria La Baja project comprises 9,000 hectares belonging to the eleven associations under the name of Asopalmas (1 to 11). There are two additional associations in the village of Macapeyo, and the municipality of La Doctrina, in the department of Cordoba. The project organizers report a total of 929 producers, 1,483 direct and 4,449 indirect jobs created, and resulting benefits for more than 25,000 people in the Maria La Baja municipality.

Puerto Wilches and Sabana de Torres

In February 2012, Indupalma awarded ownership deeds covering 2,256 hectares to 150 smallholders as part of an economic model similar to a new agrarian reform, but coming this time from the private sector. A strategic alliance created in 2002 between the banks, the private companies and the government made it possible for smallholders to access 12-year financing for buying land and establishing oil palm crops.

In the words of Indupalma General Manager, Rubén Darío Lizarralde:

> This is an example of a private sector-driven land reform (…) it is a win-win model that may be implemented for any activity: first we persuaded the smallholders to work together, then we persuaded the banks to extend loans using the land, the work and Indupalma's commitment to buy the fruit as collateral; like this we gave them good reason to believe in themselves and today we witness great results.[14]

Indupalma Ltda. is one of the leading companies in the oil palm sector, with 11,000 hectares and an industrial plant with a capacity to process 60 tons of fruit per hour. It abstained from entering the biodiesel arena because the corporate group to which it belongs had already committed itself to a different, also highly promising, oleo-chemical business – degradable detergents – as an add-on to its consolidated food and detergent businesses.

Precisely in an attempt to increase its market contribution, it decided to push the oil palm frontier. To do so, it invited smallholders organized in cooperatives to create autonomous business units such as cooperatives, microenterprises and

14 http://www.indupalma.com/boletines/nace-nueva-clase-empresarial-en-colombia

limited liability companies. The aim was to create a sustainable program of fruit suppliers in the Middle Magdalena region that would not only respond to the movements of the domestic and international markets, but would also enable sustainable development in a region suffering the scourge of violence.

Indupalma developed two projects under that scheme: Hacienda El Palmar in Sabana de Torres and Hacienda El Horizonte, in Puerto Wilches. It used the three-party model where the most important performers were the smallholders of the area, grouped in autonomous business units that would join the value chain as fruit suppliers. These projects benefit 280 associated farmers who do not only own 3,716 hectares of land but also receive 7 million dollars in loans.

The government, in turn, awarded subsidies equivalent to 40% of the crop to the smallholders. Indupalma, aside from operating and managing the project, also conducted the legal, financial and operational studies; it financed the seedlings, provided technical training, and agreed to purchase the fruit over a 28-year period, at market prices. The model is self-sustainable given that the smallholders do maintenance and harvest work on their own land with the technical assistance from the anchor company.

Each farmer purchased an individual ownership title to 10 productive hectares, including additional forest, road and other infrastructure work, under the legal procedure of *common property*[15] rights. Of these 10 hectares, 3.5 are expected to be used for paying back the loans on the land and the crop, and for meeting the basic needs of the owner families. Depending on productivity and prices, then, the remaining 6.5 hectares become the source of savings and investment.

José Palomino, a beneficiary from the El Palmar project explained: "We are no longer afraid of being out of work overnight and we are not thinking about the future of our children, because this does not worry us here; we are on our own land, we have to work hard, we have to ensure that all the fruit is of good quality so it will bring profit and help us continue working."[16]

For Indupalma, strategic alliance projects consist of several plots of land and owners who come together to develop a productive activity for profit; in this case, the owners of the project are also the owners of the land (smallholders, investors).

15 When ownership or title belongs to a community of several people with no division among them. This legal situation is derived from joint ownership of real state.

16 http://www.indupalma.com/boletines/nace-nueva-clase-empresarial-en-colombia

A key factor of these initiatives is collective responsibility; every individual is accountable to the rest. The loan collateral is provided by each of the owners, usually through a mortgage on the land or by subscribing to the Agricultural Guarantees Fund (FAG). Although the loan collateral is joint, it is guaranteed given that the operation is the responsibility of Indupalma, and a trust fund is responsible for managing the resources.

This model implemented by Indupalma enables the development of the smallholders. They become owners of productive assets and planted land, and receive technical, financial and commercial assistance.

However, it was not always this way in San Alberto; still in people's minds are those terrible times when pressure from guerillas and paramilitaries – extortion, blackmail and kidnapping – and the beginning of the economic aperture almost put Indupalma out of business. The wave of violence in the region had affected this plantation since the 1970s.

Tibu and the Catatumbo region

The development of oil palm alliances in the Catatumbo region has been swift and has happened in unplanned stages. Effectively, nearly 15,000 hectares were planted between 2003 and 2012.

Grupo Hacienda Las Flores, the same business corporation of Maria La Baja, became party to the alliance in 2003. It continued the work started in the previous decade when, in response to farmer demonstrations in 1997 and 1998, the National Government, seeking to substitute illegal crops, made its presence in Tibu, and implemented a productive project funded with resources from USAID, the Investment Fund for Peace, and the local administration.

The operational management of the project is the responsibility of Asogpados and Estam, which means that the farmers themselves lead the process towards socioeconomic development. Their objective, in particular, is to become suppliers of sustainable palm oil in the Catatumbo region, partnering with the smallholders of the area in order to make them owners of their crops. Hand in hand with this local economic development, Las Flores expects to secure the supply of its raw material, face global competition, and strengthen its pioneering position in the oleo-chemical industry.

The only oil palm development in the region dates back to the 1960s when 500 hectares were planted and Palmas Oleaginosas Risaralda Ltda. set up business

with a mill in the municipality of El Zulia. This happened in response to IFA's[17] appeal and its financial contribution to the oil palm promotion plan.

A short time afterwards, letal wilt disease attacked the plantation and only one decade later it had destroyed the palm trees, leading the owners to abandon production in 1974. Faithful to its work policies, the company transferred ownership of the crops and the mill to the employees. The workers came together under the name of Cooperativa Palmas Risaralda, still in existence, which participated as the anchor company in the first stage of this alliance. Its region of influence covers four municipalities: El Zulia, Tibu, Sardinata and Cucuta.

Several farming associations are part of this project: Asogpados, with 1,041 hectares; Asogpados Two, Asogpados Three, Asogpados Four, Asogpados Five, and Asogpados Six, each with 800 hectares; Asogpados Seven, Asogpados Eight, and Asogpados Nine, with 700 hectares each, and Asogpados Ten with 500 hectares. Additional associations are La Esperanza, with 700 hectares; Asopalcat One with 800; Asopaltibu, Napa and Asopalser with 700; Asopcalcat Two with 800 and Asopalcat Three, with 80 hectares, for a total of 11,410 planted hectares.[18]

Rosa Ana Villamizar is an associate member of Asopalcat One. She owns 20 hectares sown in company with her children, and she thanks God every day because her oil palm project has worked out:

> Now I am a business owner, my eight children are alive, and they will not have to suffer what I had to go through. Now I belong to the Community Action Committee, I am the president and I sell medicinal, cosmetic products. I thank the members of the association for the training, for the constant assistance and for the scholarships. I adore them with all my heart and I pray to God every day that they may be safe wherever they are.[19]

As a result of their commitment to environmental and social sustainability, these associations started their certification process with the Roundtable on Sustainable Palm Oil (RSPO), with financial support from the Dutch government, which entered into a three-year public-private alliance with Oleoflores. The aim is to improve conditions for oil palm growers in this region through the development and implementation of the global sustainable oil production standards.

17 Cotton Promotion Fund. It provided momentum for certain crops, including oil palm.

18 Information from the Asogpados website. http://agroindustriacolombia.com/?q=asogpados/asogpados/36

19 Acción Social; Unodc. 2010

To replicate the Maria La Baja model, Sociedad Planta Extractora del Catatumbo S.A. set up business in this area. The commercial sponsor contributed 51% and the remaining share was left to the oil palm growers of this community.

Tumaco: optimistic after a hard blow

Nariño is one the largest producers of coca and a large proportion of this activity takes place in Tumaco, where it survives in the midst of violent actions from illegal armed groups.

Oil palm crops in this municipality were first planted in the 1970s; by the first half of the 2000s they already covered 50% of the entire area planted by smallholders, with productive units of less than 10 hectares. Consequently, oil palm played an important stabilizing role in the region, solving the poverty problems as well as serving as a substitute crop in areas hitherto dedicated to illegal crops.

According to a study conducted by Mauricio Perfetti del Corral,[20] 80% of Colombian oil palm growers with less than 5 hectares lived in Tumaco in 2003. Despite this, however, the model of partnering with large companies from the region was not adopted out of an idiosyncratic reluctance to receive transfer technology for its crops.

For this reason, in 1999, seeing the experiences in other areas, oil palm companies and the local government helped with the creation of Cordeagropaz (Corporation for Agribusiness Development in Tumaco). This association of smallholders was the mechanism for obtaining loans and USAID support for planting close to 1,600 hectares.

According to the same study, oil palm crops, to some extent, stopped the expansion of illegal crops, creating a stable source of revenue for many families, activating trade, and raising the standard of living of the population.

In 2005, the planted area was approximately 35,000 hectares, representing 12% of the total area in the country, with oil production amounting to 90,000 tons per year. At the time, palm oil agribusiness in that part of the country was the most important in social and economic terms, considering that almost 27% of the inhabitants lived off a business that created 9,000 direct and indirect jobs.

20 Crece, 2003.

However, the lethal bud rot disease (or PC, as it is known in Spanish) made its appearance that same year, affecting all the plantations in the region. By 2009, it had destroyed 85% of all the crops. This forced ICA (the Colombian Agriculture and Livestock Institute) to declare a phytosanitary emergency in Tumaco in 2010.

In response to this devastation, the oil palm Federation and the Ministry of Agriculture and Rural Development designed an eradication program, with the idea of generating the conditions for recovery and creating new sources of jobs and income for an important number of small and medium holders, in an attempt to prevent them from being tempted by the illegal crops.

Already in 2012, with the support of special credit lines, a very high percentage of affected hectares had been replanted with hybrid material resistant to the disease. Some crops are already producing fruit, in what can be considered the rebirth of social oil palm growing in this region of the country.

Other productive alliances

In the departments of the northern coast there are strategic alliances with various anchor companies such as Extractora Frupalma, C.I. El Roble, Tequendama, and Palmaceites, just to mention a few.

In 2006, Extractora Frupalma S.A., in order to increase its palm core and improve the competitiveness of its products on the domestic and international markets through the use of scale economies, decided to commit to inclusive businesses with small and medium producers in the Department of Cesar. In particular, it worked with Cooperativa Campesina Integral del Cesar (Coocic) and Asociación de Palmicultores del Municipio de Curumani (Asopalmcuruma), with a 100% participation of smallholders from the municipalities of Tamalameque and Curumani.

In turn, between 2001 and 2005, El Roble entered into four alliance agreements with small and medium holders organized as associated suppliers under Aspalmag, Aspalmag II, Aspalmag III and Aspalmag IV.

CI Tequendama is part of Grupo Empresarial Daabon, which in the year 2000 started to commit to developing inclusive businesses with small- and medium holders. Its goal was to integrate them into the benefits of the oil palm productive chain, under the business opportunity framework.

The company Palmaceites S.A., created in 2005, is relatively new to the processing of oil palm fruit; it commissioned its mill in 2008 in El Reten (Magdalena). This was the joint decision of Aceites S.A., owner of 50% of its shares, and growers with productive or start-up crops who decided to come together to sell their fruit and access the added value generated by the processing plant.

In 2007, it began its experience in inclusive businesses with two alliance agreements: one with Asopalmaceite (the Oil Palm Producers Association), and the other with Asopalmaceite Two.

Finally, in the Eastern Plains, it is important to highlight the alliances created by Hacienda la Cabaña. This company has contributed consistently to the technological development of the agricultural and livestock sector in Colombia, and to the country's development. It has an alliance that involves a community of 26 displaced families relocated by Incora on a 300-hectare farm.

The fuel vs. food debate

In Colombia, global commodity stocks are under significant pressure which has resulted in higher prices. This reality is a source of worldwide concern because of what it may represent in terms of access to food for the poorest. The trend will surely continue because, on the supply side, climate change, draughts and floods will compound the problem of shortage of natural resources for food production, including water and soil. This will doubtless continue to affect yields and, consequently, the availability of staple foods. On the demand side, there is increased consumption in the emerging economies, the world population is growing, and there is an increase in the use of biofuels.

In contrast, a study by ECLAC and FAO pertaining to Latin America concluded that biofuels are not a threat to food safety given the region's potential in terms of land and food. This conclusion supported the findings of the World Bank's study, which put the boom in commodity prices into perspective. In Colombia, in particular, there are 4.9 million planted hectares and the actual potential is 21 million. Moreover, there are 38 million hectares devoted to extensive cattle farming. This land is underutilized considering that in several areas of the country, stocking rates are less than one cattle-head per hectare.

Also according to FAO statistics, the number of planted hectares in the world was 1.38 billion in December 2011, accounting for only 9.3% of the total land area. This creates a significant growth potential for farming in the world. The countries

with the largest expanses of sown land are the United States, India, Russia, China and Brazil, with farming operations on 17, 48, 7, 11 and 7% of their total area, respectively. In Colombia, less than 2% of the territory is cultivated.

Despite this reality, and although the increase in planted hectares promoted by President Uribe for biodiesel production has become an important source of well-paid rural employment and has improved the standard of living for smallholders, without jeopardizing their food safety because they also maintain staple crops, Colombia has not been left out of the international debate. This is because it is an international price taker, which means that its commodity prices increase in relation to the international prices.

In most instances, price volatility has a negative effect on the poorest population that spends over 50% of its income in food. While Colombian households spend nearly 30% of their income on food, and in India and China this figure is 40%, the average American household spends only 15%.

It is clear that supply plays a role in food safety but even if it were to increase, if it is not available to the poorest populations the threat of hunger and malnutrition remains. As reported by FAO during its 30th Regional Conference[21] in 2008: hunger persists in the region despite a 31% surplus of calorie supplies. This means that when the debate of fuels vs. food was raging at the time, America had food supplies to cover the needs of all its inhabitants.

In view of the above, it is important to be realistic regarding this debate. Lack of food may be due to economic reasons because of a lack of purchasing power, but it may also be physical due to deficient road or market infrastructures; and the main responsibility in these cases is with the governments.

In Colombia the 5th Committee of the House of Representatives, Colciencias and Universidad Nacional led[22] a debate on biofuels with the participation of both its advocates and opponents. The purpose was to promote open information and a discussion of issues of national interest to feed legislative decision-making regarding national and international concerns and the potentialities of the new biofuels business. The discussion focused on the most critical issues with the aim of building together the best scenario for biofuels in Colombia.

21 http://ipsnoticias.net/nota.asp?idnews=88081

22 Forum, "Los biocombustibles en Colombia a debate". Proceedings.

Although food safety was one of the heated topics, it was impossible to conclude that, in Colombia, food safety is under threat from renewable fuels.

Consequently, commodity price increases should not be seen as a threat in Colombia, but rather as an opportunity to strengthen the country's agricultural tradition and to achieve sustained and sustainable economic growth with enhanced benefits for rural communities.

In May 2012, in a visit to Maria La Baja to present the results of the productive alliances from oil palm, President Juan Manuel Santos stated:

> At the present time, this initiative has proven to be one of the notable development models of the country. It has not only shown that progress is possible with the alignment of the business community and the farmers, but also that when communities, industry, businesses, banks, State and multilateral agencies come together, success is possible. For this reason, the Government will replicate it in other sectors.

The truth is that, despite the government's will and interest in creating at least 100,000 rural jobs during the four years of this administration with the help of the strategic productive alliances support program (AAP), the tools to make this a reality are non-existent or unclear. A case in point is the "Equitable rural Development" program (DRE) launched in 2011, which prioritizes the allocation of subsidized loans to small- and medium holders, the first on the list being associated producers. However, it needs to be said that the share percentages established by the government for potential new projects in alliances with smallholders are not attractive to the agricultural companies. This might explain the slowdown shown in the creation of new alliances in the agricultural sector.

Colombia has important opportunities to reduce poverty in the rural areas and stabilize the income of the rural communities.

The President and the Minister of Agriculture are convinced of the potential of the high flat lands as the last agricultural frontier of Colombia capable of making the country into the food distributor of the world. According to the Government, the area potentially usable for farming is equal to 80 per cent of the land under production at the present time and holds the promise of corn, rice, sorghum, soy, sugar cane, rubber, forestry and oil palm crops, amongst others.

Although Fedepalma has voiced its views on the inconvenience of planting oil palm in this area,[23] these lands are undeniably a huge opportunity for rural growth, and should not be left only in the hands of powerful multinationals that will surely send their earnings to their countries of origin. It is up to smallholders, organized in alliances with local businesses, to take advantage of this opportunity through investments in their own areas that will result in improved quality of life for their families and communities.

23 Among other reasons, due to the lack of adequate packaging technology, unfavourable environmental conditions, poor soil quality, the persistence of long dry periods – many times with no access to irrigation – lack of infrastructure to support production, and high logistic costs for transportation of inputs and products.

Epilogue

Illustration: Fredy Espitia (2013).

Biodiesel: Here to stay?

Biodiesel and biofuels in general cannot and should not be considered the cure for the "global warming" sickness, which the planet suffers from, diagnosed by high temperatures and frequent natural disasters, which more than symptoms would appear to be some form of revenge against humankind, who are the only ones to blame for it.

The invitation to consume all types of goods and services, and consequently their greater demand, has imposed huge pressures on the planet's resources. Not for nothing the Dutch astronaut André Kuipers had the sad perspective of our planet Earth from space which, in April 2012, he shared with the rest of the world in these terms:

> We only have one Earth. From up here I can see humanity's footprint, including forest fires, air pollution and erosion.[1]

The truth is that renewable liquid fuels are only one part of the overall treatment required to arrive at the utopia of energy reconversion that must take place in a not very distant future because, if not, sooner than later the survival of future generations on our planet, as we know it today, will be jeopardized.

It is precisely because the reality is clearly showing the urgent need for intervention, that developed countries thought about biofuels as a short-term "solution" to favor their own sustainability. Biofuels legislation is changing to ensure that their use in blends with fossil fuels is compulsory, particularly in transportation, which tops the list of environmental pollutants.

This option creates a series of opportunities for poor and developing countries, rich in natural resources and biomass, because of its positive impact on agriculture and rural and social development. However, in the absence of sufficient financial resources to develop this option on their own, these poorer countries have to resort to "partnering" with other countries. This has been catalogued by different

1 "El astronauta de la ESA André Kuipers, nuevo embajador mundial de wwf desde el espacio". http://www.europapress.es/epsocial/ong-y-asociaciones/noticia-astronauta-andre-kuipers-nuevo-embajador-mundial-wwf-espacio-20120516140841.html. May 16, 2012

opponents including international organizations as a "neocolonialism" that would rapidly change world geopolitics.

It is expected that this will not be the case in Colombia, where the private sector has shown total commitment towards investments and developments in this new agribusiness, and towards growth and sustainability in the rural areas. Consequently, it reinvests into the country the resources that it generates.

Of course it would be of no surprise if the FTA with the United States created a similar situation to that in Europe where the industry received a hard blow from biodiesel imported from the US and Argentina. Many plants collapsed, quenching the enthusiasm of the investors that had placed their bets on the domestic business. It was only after three to four years of putting up with clearly unfair competition that the European Union reacted with measures to protect its industry. But it was already too late: huge damage had been done.

Despite many statements from the National Government about the possibilities for our biofuels in the neighboring country up north, as a result of the negotiated FTA, EPA's ban on imports of palm oil biodiesel into US territory is a great source of concern. It without doubt calls into question our exports to this country, and is very different to the unimpeded entrance that US biofuels have to our territory.

The agro energy business – bioethanol and biodiesel – is still young. For this reason, until other clean and affordable energy options become a reality, developing countries must make the most of their potential for producing bioethanol and biodiesel, using whatever species adapt best to their ecosystems.

Colombia is doing this, both with sugar cane for ethanol and oil palm for biodiesel. It could not be otherwise: ours is a tropical country embracing one of the highest yielding energy crops. So much so that one hectare of planted oil palm produces 1,270 gallons of biodiesel, while coconut yields 575, peanut 225, sunflower 205 and soybean 140 gallons.

The domestic agribusiness decided to position the country as a global leader in top-quality palm biodiesel. However, this is something it cannot do alone. For this reason, the private, public and academic sectors have walked hand in hand from the very beginning of this journey, and made headway despite the conflicts inherent to particular vested interests. They built from the specific to the general and gradually developed mutual trust and respect. The outcome: a new business that took shape in Colombia in very little time.

Of course there is still a long way to go. The initial local goals for biofuel blends with fossil fuel were quite ambitious: substituting 20% of the still king of fuels in diesel engines. Moreover, the three largest fossil fuel consumers in the country (Cerrejón, Drummond and Prodeco) are expected to incorporate biodiesel into their operations.[2] With that, an extra 50,000 tons of biodiesel would be added to the annual domestic production of 450,000 tons. Consequently, anyone could think that these conditions create a huge potential for the domestic market, which is already larger than the traditional food market for palm oil.

The international setting would also appear promising for our native biodiesel, given its exceptional qualities[3]. For example, it could be sold successfully in the European Union, a big world consumer, among other reasons because the member countries set equally high standards as Colombia in order to reduce the environmental impact of their activities. These standards were set forth in the 20-20-20 initiative for 2020 consisting of 20% use of renewable energies as part of total consumption, 20% reduction of greenhouse gases in relation to 1990 levels, and 20% improvement in energy efficiency.

However, given today's reality in Colombia, these are dreams. Are they achievable? Yes, but there is still a long way to go. Reaching commercial maturity requires actions in many areas in which, as in the past, public, private and academic sectors have to be committed to advance together towards a common destination: the benefit of the country. Unfortunately, this today is not so clear given the sense of separation among them, which is generating a large amount of uncertainty for the immediate future.

Technical issues are among the aspects requiring some work. Problems such as haze[4] and others that occur outside the factories, in the gas stations or during biofuel transportation, have to be addressed. Some are beyond the control of

2 These are multinational coal companies. Because they are classified as "big consumers" they are granted special benefits, for example, the option to import diesel for their machines directly, and they do not have the obligation of blending it with Colombian palm oil biodiesel. The National Biofuels Federation (Fedebiocombustibles) is promoting a project to change this situation by 2013.

3 Colombian biodiesel meets the highest quality standards. Moreover, the oil palm crops from which it is derived do not endanger native or protected woodlands; and because of surplus production, it does not jeopardize food safety. For additional information on the criticisms against palm biodiesel, see Chapter 5 of this book.

4 Haze or sterol glycoside is a solid that forms at temperatures near the pour point of biodiesel. For additional information, see Chapter 4 of this book.

the biodiesel producers, in particular those associated with biofuel handling throughout the supply chain.

But the most important issue is economic. The promising domestic industry must be given its freedom. In this way, it would not have to rely on the action or inaction of the different governments in power. Although in rich countries this industry receives, and will continue to receive, incentives granted not only to the agricultural sector, which is the source of the raw materials, but also to biodiesel producers, favoring their competitiveness on the international markets, our industry needs to find alternatives that strengthen it and distinguish it from its competitors.

Just like the old saying goes, "Getting there is one thing, but staying there is another". Although biodiesel producers have worked very hard to enter this new energy market, monopolized by giant multinationals zealously guarding their position globally, it is clear that maintaining their hold there, which involves huge political and economic pressures, will be very difficult, particularly in the absence of regulatory stability and clear domestic policies on biofuels.

Legislation Appendix. National Biodiesel Program

Conpes

- **CONPES 3510/08.** "Policy guidelines for the promotion of sustainable biofuel production in Colombia."

Laws

- **Law 939/04**. Whereby the procedural errors in the passing of Law 818 of 2003 are addressed, and the production and sale of biofuels from plant oil or animal fat for use in diesel engines are encouraged, and other provisions are determined.
- **Law 1083/06.** Sets forth standards for sustainable urban planning.
- **Law 1028/06.** Whereby additions are made to the Criminal Code in relation to seizure of hydrocarbons, their by-products, biofuels or blends containing them, and other provisions are established.

Decrees

- **Decree 3492/07.** "Which regulates Law 939 of 2004."
- **Decree 2629/07.** "Which sets forth provisions for the promotion of biofuel in the country, as well as measures applicable to motor vehicles and other devices using fuels for their operation."
- **Decree 1203/07.** "Whereby an authorization is granted to Ecopetrol S.A.."
- **Decree 2594/07.** Establishes a venture capital fund to support productive initiatives, including biofuel projects.
- **Decree 4051/07.** "Whereby decree 2685 of 1999 is partially amended and other provisions are determined" - permanent free-trade zones.
- **Decree 2328/08.** "Whereby the Inter-sectorial Commission for Biofuel Management is created."
- **Decree 4892/11.** "Whereby provisions are passed pertaining to the use of alcohol fuels and biofuels in motor vehicles."

Resolutions

- **Resolution 180158/07.** Whereby clean fuels are determined in accordance with the provisions in the paragraph of Article 1 of Law 1083 of 2006.
- **Resolution 182142/07.** Registry of producers and/or importers of biofuels for use in diesel engines.
- **Resolution 182087/07.** Criteria for quality of the biofuels for use in diesel engines.
- **Resolution 180106/08.** Sets forth provisions related to the price structure of diesel fuel and its blends with biofuel for use in diesel engines.
- **Resolution 180462/09.** Whereby Resolution 82439 of December 23rd, 1998 is amended and provisions are set forth in relation to the price structure of diesel fuel and its blend with biofuel for use in diesel engines.
- **Resolution 180494/09.** Whereby maximum rates for biofuel transportation are established for the supply plants located in the south and southwest of the country, and a paragraph is added to Article 3 of Resolution 181780 of 2005.
- **Resolution 180134/09.** Whereby Resolution 182158 of December 2007 is modified, in relation to the price structure of diesel fuel blended with biofuel for use in diesel engines.
- **Resolution 182111/09.** Whereby Resolution 182142 of 2007 is modified, in relation to the program for biofuel blends for use in diesel engines.
- **Resolution 182367/09.** Whereby Resolution 182142 of 2007 is modified, in relation to the program for biofuel blends for use in diesel engines.
- **Resolution 181966/11.** Whereby some items under Article 2 of Resolution 181780 of December 29th, 2005 are modified, in relation to the income for the producer of biofuel for use in diesel engines.

Technical Standards

- **NTC 5444.** Biodiesel for use in diesel engines. Specifications.
- **NTC 1438 7th update.** Oil and its by-products. Fuels for diesel engines.
- **NTC 5708.** Biodiesel B100 for diesel engines. Land transportation in tank trucks.
- **GTC 213.** Sustainability guideline for biomass in its stages of production and processing within the biofuel productive chain in Colombia.

Bibliography

Acción Social; Unodc. 2010. *Del campo a la ciudad. Programa Familias Guardabosques y Programas Proyectos Productivos*. Presidencia de la República, Oficina de las Naciones Unidas contra la Droga y el Delito. Colombia. 225 p.

Acosta, A. 2010. Los biocombustibles: oportunidad o amenaza. Bogota. *En Amylkar Acosta Medina*. www.amylkaracosta.net (Consulted: March 20th, 2012).

Acosta, A. 2010. La hora del biodiésel. Bogotá. *En Amylkar Acosta Medina*. www.amylkaracosta.net (Consulted: March 20th, 2012).

Acosta, A. 2011. El reto de los biocombustibles. Bogotá. *En Amylkar Acosta Medina*. www.amylkaracosta.net (Consulted: March 20th, 2012).

Acuña A., Mauricio. 2007. La palma de aceite: una industria de grandes perspectivas. En: celebración de los 45 años de Fedepalma. *Palmas* (Colombia) 28 (4): 451-53.

Acuña A., Mauricio. 2007. La palma de aceite colombiana avanza en sostenibilidad y competitividad. En: acto de instalación del XXXV Congreso Palmero, mayo 27 a junio 1 en Cali. *Palmas* (Colombia) 28 (2): 130-137.

Acuña A., Mauricio. 2006. Palabras del Presidente de la Junta Directiva de Fedepalma. En: XXXIV Asamblea General de Fedepalma. Villavicencio, junio 7-9 Villavicencio. *Palmas* (Colombia) 27(2): 92-99.

Acuña A., Mauricio. 2005. En: Instalación Congreso Nacional de Cultivadores de Palma de Aceite XXXIII. Cartagena, junio 8-10. ¿Hacia dónde va el sector palmero en Colombia? *Palmas* (Colombia) 26, No. Especial. pp. 9-22.

Acuña A., Mauricio. 2005. Palabras del Presidente de la Junta Directiva de Fedepalma. En: Acto de clausura del XXXIII Congreso Nacional de Cultivadores de Palma de Aceite. Cartagena, junio 8-10. *Palmas* (Colombia) 26, No. Especial. pp. 217-224.

Agudelo, J.R.; León D.; Mejía R. 2001. El aceite de palma transesterificado por metanólisis como biocombustible para motores diésel. *Revista Facultad de Ingeniería* (Colombia) 24: 47-57, diciembre.

Amigos de la Tierra, Life Mosaic y Sawit Watch. 2008. *Losing Ground: The Human rights impacts of oil palm plantation expansion in Indonesia*. Indonesia. 108 p.

Arias, A. 2007. Los biocombustibles en Colombia. Cartagena. En Ministerio de Agricultura y Desarrollo Rural. www.minagricultura.gov.co (Consulted: March 15th, 2012).

Banco Mundial. 2011. *Marco conceptual del grupo del Banco Mundial para su participación en el sector del aceite de palma*. Washington (Estados Unidos). 105 p.

Bioenergy and Food Security Criteria and Indicators (BEFSCI). 2010. Recopilación de iniciativas para la sostenibilidad de la bioenergía. FAO. Roma (Italia).

Banco Interamericano de Desarrollo (BID). 2009. Scorecard sobre sostenibilidad de biocombustibles. Washington (Estados Unidos).

Becerra, Manuel. 2004. *Desempeño ambiental del sector palmero en Colombia, evaluación y perspectivas*. Fedepalma (Colombia).

Bravo, Elizabeth. 2009. Biodiésel: Jatropha (piñón manso) y el despojo de tierras. En *Nextfuel*. www.biodiesel.com.ar (Consulted: May 9th, 2012).

Carrillo, R. 2009. *Los biocombustibles en Colombia: un reto para el desarrollo sostenible*. IAvH. Bogotá (Colombia).

Cano, C.G. 2006. *Después del TLC ¿qué?* Intermedio Editores (Colombia) 278 p.

Castro P.; Coello J.; Castillo-Lima, L. 2007. Opciones para la producción y uso del biodiésel en el Perú. En: *Soluciones Prácticas ITDG. Tecnologías desafiando la pobreza*. Serie libros No. 51.

Cenipalma; Ecopetrol S.A.; Sí 99; Fedepalma. 2009. Pruebas de larga duración con biodiésel de palma en una flota de servicio público. Convenio de cooperación técnica Cenipalma No. 071-05, Ecopetrol S.A.-ICP No. 003/05, Sí 99, Fedepalma.

Cenipalma. 2012. Subproductos. Bogotá. En Cenipalma. www.cenipalma.org (Consulted: April 30th, 2012).

Cepal. 2008. *Panorama de inserción internacional de América Latina y el Caribe 2007, Tendencias 2008*. Santiago de Chile (Chile). 207 p.

Chin, M. 2011. *Biofuels in Malaysia. An analysis of the legal and institutional framework. Cifor*. Bogor (Indonesia). 29 p.

Colombia. Departamento Nacional de Planeación, Consejo Nacional de Política Económica y Social. 2008. *Estrategia para el desarrollo competitivo del sector palmero* (Documento Conpes 3477).

Colombia. Departamento Nacional de Planeación, Consejo Nacional de Política Económica y Social. 2008. *Lineamientos de política para promover la producción sostenible de biocombustibles en Colombia* (Documento Conpes 3510).

Crece. 2003. *Impactos socioeconómicos de la agroindustria de la palma de aceite en Colombia*. Manizales (Colombia). 120 p.

Daabon Organic. 2009. Planta de Biocombustibles Sostenibles del Caribe S.A. inaugurada 3 de febrero de 2009 por el señor Presidente de Colombia Álvaro Uribe Vélez. *Boletín Fair News:* 1.

De Hart V., César. 2004. Hechos, suposiciones y consideraciones sobre la palma de aceite y su competitividad. En: XXXII Congreso Nacional de Cultivadores de Palma de Aceite, junio 2-4 Santa Marta (Colombia). *Palmas* (Colombia) 25 (2): 77-86.

Ecole Polytechnique Federale de Lausanne (EPFL). 2008. La Mesa Redonda sobre Biocombustibles Sostenibles. En RSB www. rsb.epfl.ch (Consulted: January 15th, 2012).

EMPA. 2012. "Evaluación del ciclo de vida de la cadena de producción de biocombustibles en Colombia". Fedepalma (Colombia).

Escobar, J. *et al*. 2009. Biofuels: Environment, technology and food security. *Renewable and Sustainable Energy Reviews* 13 (Issues 6-7). pp. 1.275-1.287.

Fargione *et al*. 2008. Land clearing and the biofuels carbon debate. *Science* 319 (5867): 1235-1238.

Fedebiocombustibles. 2011. Biodiésel colombiano, el mejor entre los mejores del mundo. En: *El Tiempo*, información comercial, 13 de mayo.

Fedebiocombustibles. 2012. Doce principios y criterios forman el núcleo de la Norma RSB. En Fedebiocombustibles www.fedebiocombustibles.com (Consulted: January 15th, 2012).

Fedepalma. 2007. Biocombustibles: el renglón más promisorio de la economía. *El Palmicultor* 438, agosto de 2008.

Fedepalma. 2007. En marcha primera planta de biodiésel. *El Palmicultor* (422): 1, 27, abril.

Fundación para la Educación Superior y el Desarrollo, Fedesarrollo (Colombia). 2011. Caracterización del empleo en el sector palmicultor colombiano. *Cuadernos Fedesarrollo*, 37.

Fian Internacional. 2009. Resultados de la Misión internacional de verificación sobre los impactos de los agrocombustibles en Colombia. Heidelberg (Alemania) 42 p.

Gazzoni, D. L. 2009. Biocombustibles y alimentos en América Latina y el Caribe. IICA. San José (Costa Rica).118 p.

Global Bioenergy Partnership (GBEP). 2010. Un compromiso global para el desarrollo de la bioenergía. FAO. Roma (Italia).

Greg, P. 2005. *Biodiesel. Growing a New Energy Economy*. Chelsea Green Publishing Company, Vermont (Estados Unidos). 281 p.

International Energy Agency (IEA). 2011. Technology Roadmap: Biofuels for transport. IEA/OECD. Paris (Francia) 51 p.

Instituto Interamericano de Cooperación para la Agricultura (IICA). 2010. *Atlas de la agroenergía y los biocombustibles en las Américas: II Biodiésel*. San José (Costa Rica). 346 p.

International Center for Trade and Sustainable Development (ICTSD). 2011. Sustainability Criteria for Biofuels Up and Running. En ICTSD www.ictsd.org (Consulted: March 11th, 2012).

Kovacevic, M. 2012. La política estadounidense sobre biocombustibles excluye el aceite de palma de Indonesia y Malasia en medio de las protestas de la industria. En Forests News www.blog.cifor.org (Consulted: April 29th, 2012).

Fedepalma. 2011. Potencial de la palma de aceite en la producción de energías renovables. *En Congreso Mundial de Energías Renovables* 2011. Fedepalma www.fedepalma.org (Consulted: February 15th, 2012).

Mesa, Jens. 2009. *Lo gremial, pilar del desarrollo palmero*. Fedepalma (Colombia). 186 p.

Ministerio de Ambiente, Vivienda y Desarrollo Territorial; Instituto de Hidrología, Meteorología y Estudios Ambientales (Ideam). Embajada de Holanda. (s.f.) *ABC del cambio climático*. Colombia.

Ministerio de Minas y Energía. 2009. *Biocombustibles: Fuente de desarrollo sostenible para Colombia*. Bogotá (Colombia).

García, Jesús *et al*. 2010. Pruebas de larga duración con biodiésel de palma en una flota de camiones de transporte. Informe final ejecutivo. Ministerio de Minas y Energía; Cenipalma; Ecopetrol S.A.

MPOB. 2005. Report on Biodiésel for Fedepalma. Kuala Lumpur (Malasia). 46 p.

Ortegón Salinas, Samuel. 2012. *El aceite que resucitó a Maria La Baja*. Revista *Semana*. En: www.semana.com (Consulted: May 14th, 2012).

Ospina, M.; Ochoa, D. 2001. *La palma africana en Colombia. Apuntes y Memorias* (volumen 1). Fedepalma (Colombia). 235 p.

Oxfam International. 2008. *Otra verdad incomoda*. Oxford (Inglaterra). 67p.

PNUD. 2009. Indupalma: Los campesinos aliados de Indupalma: antes jornaleros, ahora dueños de tierras y empresarios. En Crecimiento de mercados inclusivos. Estrategias empresariales para la superación de la pobreza y la exclusión en Colombia: 112-115. Bogotá (Colombia).

Portafolio. 2010. Presidente Uribe 'bendijo' planta de biodiésel en Meta, cuyo costo asciende a los US$50 millones. En *Portafolio* www.portafolio.co (Consulted: March 20th, 2012).

Razak, N. 2012. 1MBAS to Strenghten National Biomass Strategy, Attract more investments. En 1 Malaysia. www.1malaysia.com.my (Consulted: April 30th, 2012).

Revista Dinero. 2009. Palmeros sacan provecho del cambio climático. En *Dinero* www.dinero.com (Consulted: April 30th, 2012).

Revista Dinero. 2010. Brasil lanza producción sustentable de palma africana en Amazonia. En *Dinero* www.dinero.com (Consulted: April 28th, 2012).

Rojas, M. 2006. "Evaluación del funcionamiento del motor diésel con biodiésel de palma". Tesis de Maestría para optar al título de ingeniero automotor. Universidad Tecnológica de Chalmers (Suecia).

Rojas, Mauricio. 2007. Assessing the Engine Performance of Palm Oil Biodiesel. *Biodiésel Magazine*. Agosto.

Sarmiento J.; Duarte D.; Torres J.; Cuéllar, M. 2006. Evaluación de mezclas de aceite y biodiésel de palma con combustible diésel. Convenio de Cooperación Técnica. Ecopetrol S.A.-ICP 003 de 2005. Cenipalma 071-05.

Silva, A. 2007. Alimentos y biocombustibles: Conflictos y oportunidades. *El Palmicultor*, (425): 2, julio.

Silva, E. E.; Yáñez, E.; Andrade, E. 2007. El balance energético en la producción de biodiésel de palma: Dos estudios de caso Brasil y Colombia. *Palmas* 28 No. Especial (2): 73-78. Bogotá (Colombia).

Unctad/escap. 2001. *The case study on the Malaysian Palm Oil*. Bangkok (Tailandia).

Universidad Nacional de Colombia, Colciencias y Cámara de Representantes. 2009. *Los biocombustibles en Colombia a debate*. Bogotá (Colombia). 227 p.

UPME. 2009. *Biocombustibles en Colombia*. Ministerio de Minas y Energía. Bogota (Colombia).

USAID- Acción Social. 2009. Portafolio de proyectos de palma de aceite apoyados por USAID. En Fedepalma. www.fedepalma.org (Consulted: January 12th, 2012).

USAID, SNV, Fedepalma. 2010. De las alianzas productivas a los negocios inclusivos. Bogotá (Colombia).

Van Der Velde, L. 2010. *Biocombustibles (1): los diferentes debates*. En Grupo de Estudios Internacionales Contemporáneos (GEIC).

Vermeleun, S.; Goad, N. 2006. *Towards better practice in smallholder palm oil production*. International Institute for Environment and Development. Londres (Inglaterra).

World Growth. 2011. *The economic benefit of palm oil to Indonesia*. Arlington (Estados Unidos).

Yáñez, E.; Lora, E.; Ugaya, C.; Venturini, O. 2008. *Sensibility analysis of the cogeneration using biomass on life cycle assessment for palm oil biodiesel*. ECOS. Itajubá (Brasil).