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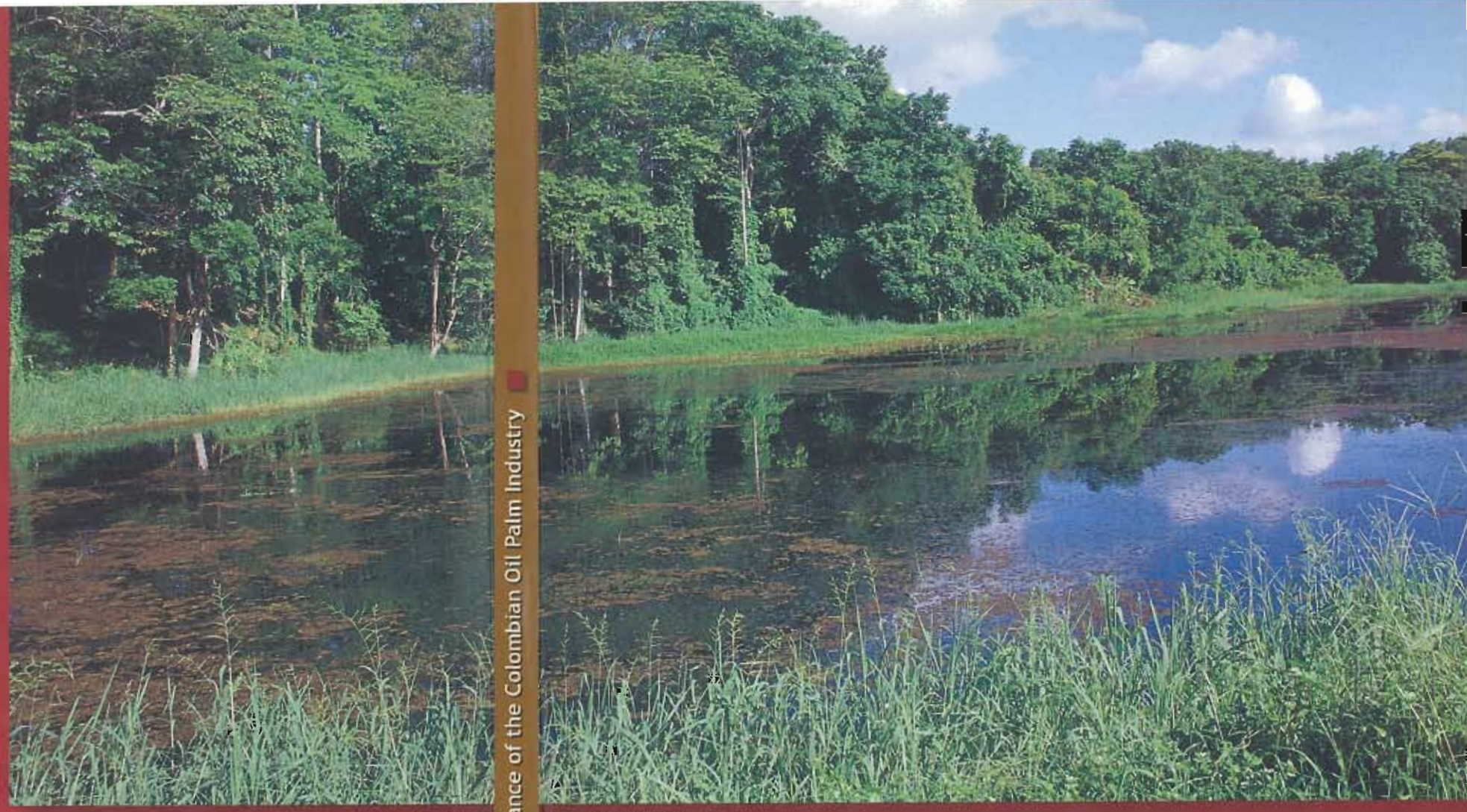

Environmental Performance

of the Colombian Oil Palm Industry

MANUEL RODRÍGUEZ-BECERRA
BART VAN HOOF

fedepalma

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Forward

nvironmental management is an important issue across the oil palm agroindustry. Its importance needs to be seen in a global context. Today, society in general is even more environmentally-aware and indeed expects industry to implement environmentally-friendly and sustainable policies which protect the environment as a whole.

As a result, it is essential to support the Colombian oil palm sector so that it continues to be competitive in markets dominated by free trade policies. It is also important to support the palm sector so that it can effectively meet international consumer demands.

The oil palm sector due to its very nature and presence in global markets needs to be aware of global trends and progress in environmental protection. Today, society places much more importance on industries, particularly those producing raw materials and food, to be environmentally-friendly and aware.

Recently, consumers have placed even greater importance on the environmental impacts of a product than its cost. Thus the competitiveness of oil palm farming is closely linked to the way it perceives and practices environmental management.

Sustainable development in any business is based on the following three main goals: *people, planet and profits*. This means that businesses need to be committed to carrying out the demands of *people* and the *planet* while also keeping an eye on profits.

Today private companies have more social responsibilities and commitments. As a result, businesses cannot get away with just reducing production costs and increasing output. Business strategies must now include global environmental trends and promote policies which effectively use developments in environmental protection to their advantage.

As a result of new environmental and social demands, it is essential that the oil palm agroindustry evaluates and reflects upon its environmental performance and management and implements new strategies for improvement. It is well known that in the past non-governmental organizations have criticized palm farming, claiming it harms biodiversity. These views are particularly pertinent in Colombia as it is one of the most megabiodiverse countries in the world.

Colombia's biodiverse communities are not only found in its state national parks and forest reserves but also on private and community lands. In such way, Colombian society as a whole plays an important role in preserving the country's rich flora and fauna and ecosystems. It is important to note that many natural ecosystems are located in palm farms and palm growing areas. For this reason, the palm sector needs to promote good working relationships with environmental authorities and local communities and continue to strive towards sustainable development.

Fedepalma, being the union which represents the interests of palm growers, must be in touch with the demands and challenges placed on the sector by environmental management issues. Colombia's environmental legislation and policy is one of the most advanced in the continent. Furthermore, the Colombian government is committed to the various international environmental treaties it has signed and ratified. During recent years, Fedepalma has been working closely with the Colombian government, promoting environmental protection in general. Fedepalma believes that protecting the environment is not only important in terms of social responsibility but also because good environmental management practices means good business and greater profits across the palm sector.

To promote environmental management across the palm sector, Fedepalma in collaboration with The Organization for Sustainable Business Performance (ODES) has been promoting research that focuses on environmental performance across the sector. Fedepalma's Environmental Management Research Program is responsible for overall research supported by the Federation's Communications Office.

The aim of this book is to act as a guide for palm companies seeking to improve environmental sustainability and enhance their competitive edge. To this end, Fedepalma has carried out research into the environmental impacts of the oil palm agroindustry and how the sector uses renewable natural resources.

The future of environmental management in the oil palm sector is firmly based on and influenced by global developments and trends in the agroindustry. It is also influenced by threats posed by its international competitors and the sector's strategic vision for the year 2020 which aims to increase palm oil production sevenfold.

In practice, increasing palm oil production levels means that the Colombian palm sector will have to export at least 80 per cent of its produce. This challenge becomes even more attainable if the Colombian palm industry adopts highly competitive environmental management systems.

The results of the research discussed throughout this book also emphasize the need to focus on transparency across the sector in general and provide clear data about the sector's environmental performance. This plays an important role in promoting the palm industry as one which is environmentally-friendly.

Furthermore, during the last decade, the palm sector has been made great strides in complying with environmental legislation. For example, The Treaty on Clean Production, signed by members of the Colombian palm sector and various environmental authorities, has guided developments in environmental management across the sector. In general, the treaty has helped the palm industry to promote the use and management of renewable natural resources, research, use and sharing of clean technologies and implement ecological and environmental management plans. In addition, The Oil Palm Research Center (Cenipalma) has played a fundamental role in developing environmental management systems in the agroindustry.

Research has also shown that is it important that the Colombian palm industry is in line with global environmental criteria and standards. Thus the challenge in the future is for Colombian palm companies to adopt good practices in environmental management that promote their competitiveness in the global market.

Furthermore, it is essential that those palm companies who have not begun to formalize their quality and environmental management systems do so immediately. In the near future, certified companies and those in the ISO 9000 certification process will have to obtain the ISO 14000 certification and adopt the ISO 14001 environmental management system. Thus irrespective of demands placed on the sector by environmental authorities, palm companies will be well on their

way in improving environmental management systems through certification processes. It is also important to note that gaining environmental management certification plays an important role in the success of oil palm derivative exports.

Research into environmental performance in the palm sector has also highlighted positive trends in plantation management in Colombia. Good practices need to be further strengthened and shared so that palm farming is seen as an environmentally-friendly industry.

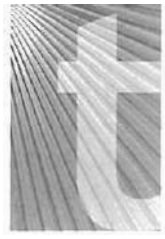
Such good practices can be seen in organic farming and should be encouraged. In Colombia, there are many organic oil palm plantations in operation which by their very nature are environmentally-friendly. The future success of organic palm farming in Colombia depends on consumer demand for organic products and what steps Fedepalma and the Colombian government take to promote organic palm farming.

With regards to mills, the main challenge is zero emissions. This means promoting product recycling and the efficient use of all byproducts produced in the agroindustry. In turn, this enhances the notion that good environmental management can lead to increased profits and production levels.

Finally, adopting environmental policies and practices which benefit society, environment and the world as a whole, lies largely with oil palm growers. Let's get to work.

Jens Mesa-Dishington
President of Fedepalma

Introduction



he aim of this book is to analyze the developments, trends and future prospects of Colombia's oil palm agroindustry with regards to the environment. The book will also explore to what extent the oil palm industry is compatible with the environment and how the issue of the environment may actually strengthen and add to the competitiveness of the oil palm industry.

The book is based on results from research commissioned by the National Federation of Oil Palm Growers (Fedepalma). Research was carried out by The Organization for Sustainable Business Performance (ODES), who are the authors of this book. It is important to emphasize that the research team, while carrying out their investigations, were autonomous and independent of Fedepalma. Industry leaders see this study as an independent assessment which can be used to identify the oil palm industry's strengths, weaknesses and possible impact on the environment.

This study includes an analysis of the oil palm industry's current practices and priorities and possible developments in the field of environmental management. Based on national and international trends, the study will analyze the oil palm industry particularly in relation to forests, water, soil, biodiversity and the atmosphere.

The book also highlights the main types of practices used, in particular: environmental-friendly technology, prevention and mitigation measures and how to control impacts on the environment. Also, how efficient these practices are and ideas about the sustainability and competiveness of the oil palm sector will be examined.

Lastly, the study includes recommendations about how to improve environmental management and how to enhance those processes which ensure the sustainability of resources and protection of the environment, taking into account national and international policies and trends.

Examples of some of the issues discussed are: the use of fuel and energy, participating in markets which require environmental-friendly goods and eco-efficient systems, the ideas and policies of environmental authorities, consumer views and trends and finally market behavior in relation to palm oil products.

The main aims of the study are:

- To highlight how the different stages of production, for example farming and the oil palm extraction process, impact on the environment. This also involves looking at the industry in terms of its relationship, both direct and indirect, with various renewable natural resources and their environments.
- To identify prevention, mitigation and control measures and their impact on the environment and to judge their effectiveness according to each individual case study.
- To highlight the different types of technology used now and in the past.
- To make recommendations within the context of national and international policies and trends, in order to improve environmental management and enhance those processes which ensure the sustainability of resources and the protection of the environment. While at the same time, promoting the competitiveness of the oil palm sector.

The scope of the study

The study focuses on those palm businesses with mills. In addition, the study includes a preliminary investigation about the environmental sustainability of small-scale cultivations which do not have mills. The most important environmental issues are: forests, biodiversity, soil, water, the atmosphere and the handling of byproducts.

Sources used

The study is based on information from the following sources:

Data provided by Fedepalma, the Oil Palm Research Centre (Cenipalma) and reference to second hand sources, such as books and magazines.

Interviews conducted with experts in the field.

Field visits to plantations and mills located across Colombia's various palm growing regions.

A survey sent to 50 businesses who operate mills about their views on environmental management and current practices. As 31 companies replied, it was only possible to highlight some trends rather than provide pertinent sound observations about what businesses think about environmental management now and in the future and the oil palm sector as a whole.

Environmental Issues - Origin and Development

CHAPTER 1

Guacavia river, Meta.

uring the last three decades, environmental issues have become more of a priority and gained importance both in Colombia and globally. This chapter will discuss the main implications this has had on the Colombian oil palm sector, particularly in terms of the industry's competitiveness and the practice of environmental management in oil palm companies.

The Environment - Global Views and Developments

It was barely thirty years ago that public interest in environmental issues started to grow globally. However, environmental issues really started to gain impetus during the 1960's in developed countries benefiting from the economic boom after the Second World War. These countries now had to deal with the hazardous effects of industrial pollution and its impact on the quality of life and on strategic ecosystems.

It was at the 1972 United Nations Conference on the Human Environment in Stockholm where threats to the global environment were first discussed and dealt with in a systematic way. Yet it is important to note that decades before the Stockholm Conference, environmental issues had gradually become more important. During the last three decades, the issue of the environment has played an increasingly important part in formulating national and international policy. The Stockholm Conference showed that countries shared many of the same environmental problems and concerns, in turn prompting further regional and global agreements. The Stockholm Conference also pushed signatory states to tackle their own environmental problems on the domestic front.

Yet despite the progress made at the Stockholm Conference, environmental problems have continued to cause global concern during the last twenty years. Such concerns led to the next major United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The agreements signed by the 120 heads of state marked a turning point in international relations and the environment. The following agreements were signed at the Rio Conference: Conventions on Climatic Change and Biodiversity, Declarations on the Environment and Development, Declarations on Forests and a global plan of action aimed at sustainable long-term development, known as Agenda 21. Furthermore, following the Rio Conference new agreements have been reached during the last decade, including the recent Johannesburg Summit in 2002 (Rodríguez, 1994, UN, 1992).

Environmental priorities have been changing and many of the major environmental threats today were unknown even just a few years ago. For example, at the time of the 1972 Stockholm Conference, there was little understanding of the following most important ecological problems: global climate change, the depletion of the ozone layer, persistent organic pollutants (one of the major threats facing ocean life) and environmental risks posed by releasing modified living organisms.

Furthermore, as a result of research carried out during the last 30 years, there is greater understanding of certain environmental problems such as loss of biodiversities, deforestation, soil erosion and degradation, deterioration of fresh water sources and the pollution of marine environments. In the last decade, concerns about the decline of biodiversities have increased particularly in countries located in the tropics where rich biodiversities are found. In the future, the loss of biological resources may make life support systems vulnerable and pose threats to human food chains.

To tackle these problems, numerous multilateral legally-binding measures (known as agreements) as well as non-binding measures (programs, declarations) have been ratified. Many of these agreements have also been ratified by Colombia, demonstrating the country's will to push ahead with its national environmental legisla-

tion. At the same time, ratified global programs and declarations have often prompted far reaching national environmental policies as for example, the National Forest Development Plan (MMA, 2001). Furthermore, at the recent Johannesburg Conference, a new way of combating environmental threats emerged. This involved forging partnerships between private sector organizations, non-governmental organizations and public sector organizations aimed at developing specific programs to deal with important environmental issues. This can be seen as part of general agreements reached on issues such as cleaner production among public and private organizations in Colombia.

To summarize, it is important emphasize that the origin and development of environmental management in Colombia must be seen in the context of the development of environmental issues at the global level. Environmental treaties and agreements are products of glo-

The *Río Negro* river basin, Guayuriba, Meta.

balization and affect environmental management in the oil palm sector in many ways. As a result, the oil palm industry needs to adhere to environmental legislation and respond to challenges regarding the competitiveness of the oil palm sector in international markets.

State Environmental Policies and their Implementation in Colombia - Views and Developments

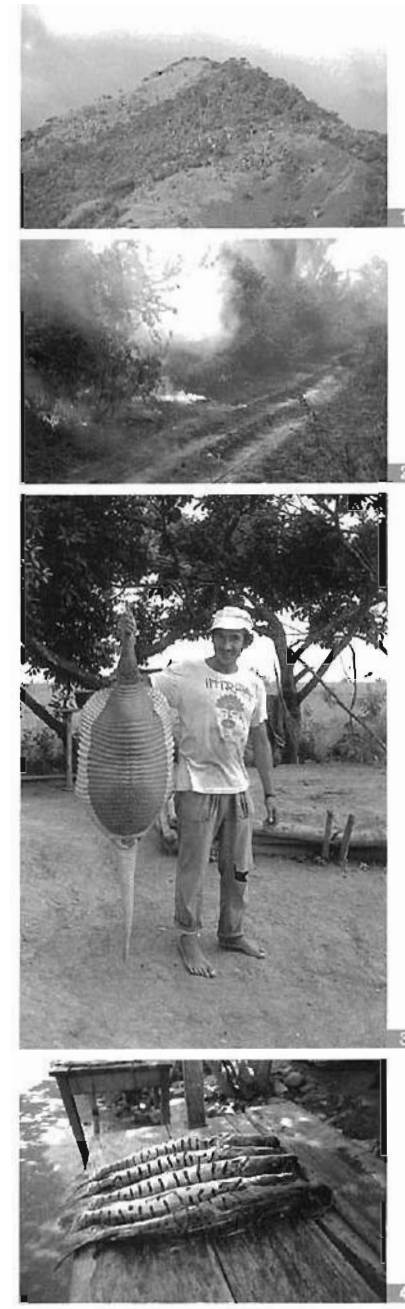
Until 1970, in Colombia and in other developing countries, environmental issues were not really taken into account and considered. During this time, most Colombians viewed the earth, water and forests as infinite and inexhaustible resources. Bearing this in mind, it is not surprising that there were no unions or federations in Colombia, including Fedepalma, which considered environmental issues as a priority. However from the early 1970's onwards, environmental issues tentatively started to form part of state public policy in Colombia.

In 1974, following agreements reached at the Stockholm Conference, the Colombian government implemented a series of laws dealing with natural resources and the environment. A few years earlier, the Colombian government also founded the National Institute of the Environment and The Institute of Renewable Natural Resources (Inderena) which has become the country's leading authority on the environment. During the 1990's, Colombians played a more important role in terms of protecting their environment as seen in the introduction of institutional reforms implemented in 1991 and 1993. These reforms were partly in response to the United Nations Conference on Environment and Development. The reforms of the 1990's were based on some sixty articles written about environmental development which were included in the 1991 national constitution and in law 99 of 1993. The subsequent creation of the Ministry of the Environment and the National Environmental System (Sina) formed an important basis of these reforms.

One way of evaluating to what extent environmental management has developed in Colombia during the last decade, is to compare

Colombia with other countries. Recent studies show that environmental institutions in Colombia are some of the most advanced and developed in Latin America and the Caribbean, alongside Brazil, Costa Rica, Chile and Mexico (Rodríguez, Espinoza, 2002; Bárcena y De Miguel, 2001; Brañes, 2001; Quiroga, 2001; WB, 2000).

The strengthening of Colombia's national institutions has been vital in order to protect, conserve and restore the country's sense and awareness of the environment today and in the future and to stop and reverse practices that damage the environment and lead to air pollution. This has been achieved by implementing numerous initiatives such as policies, plans, programs and projects, all pushed forward both by the government and by public organizations and those private sectors proactive in environmental issues (see table). Many of the above achievements can be seen, to a large extent, as part of Colombia's response to the Earth Summit. But it must be noted that while there have been improvements, the destruction of the environment has continued. Examples of such destruction include: the deterioration of the urban environment and dwellings in some cities, continued deforestation and pollution of various regions and local communities, an increase in the number of regions where flora and fauna are at risk of extinction, increasing soil erosion in some agricultural areas, an increase in the number of natural disasters and forest fires, a rise in air pollution in some big cities and an increase in marine life pollution alongside diminishing fish stocks in general.



1. Deforestation - Santa Marta mountain range.
2. Forest fires - Cesar province.
3. Species at risk of extinction - Meta province.
4. Loss of fish stocks - Magdalena river.

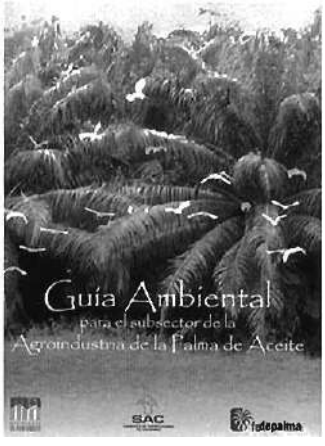
Advances in environmental issues during the last decade:

1. The 1991 Colombian national constitution included and incorporated a number of issues dealing with the environment.
2. Creating new legislation and norms and updating existing laws.
3. Giving environmental issues a higher profile in government policy. Improvements in the development of environmental policies at the national, regional, departmental and municipal level.
4. Expanding the environmental agenda, particularly in relation to the agreements reached during and after the Earth Summit. Issues include: biodiversity and the sustainable management of forests, climate changes, desertification, bio-safety, sea pollution and persistent organic pollutants.
5. Giving environmental authorities a higher profile and more importance within public administrations through the creation of the Ministry of the Environment.
6. Updating existing state procedures and norms based on command and control: i) direct regulating mechanisms - norms dealing with environmental quality and more appropriate environmental standards; ii) administrative procedures and systems - those that involve granting all types of environmental licenses and permits, including those that deal with the use of natural resources and the environment. Using environmental licenses as a way to improve environmental management in key industries (for example hydrocarbon, mining and state highway construction industries). Developing legislation regarding land use across more than 50 per cent of the country's municipalities.
7. Introducing new economic incentives and updating existing ones (for example, favorable tax and use rates).
8. Granting and clarifying property titles where land is deemed environmentally important. This includes recognizing the territorial rights of indigenous and Afro-Colombian communities in areas they have historically inhabited.
9. Introducing new ways and tools with which to practise environmental management, such as agreements on cleaner production systems.
10. Promoting and allowing greater decentralization and autonomy in environmental management through the introduction of Autonomous Regional Corporations. Also includes consolidating Sina.
11. Promoting various ways by which the public and private sectors can play a more important role in environmental management (for example, introducing public forums and The Environmental Action Fund).

12. Empowering the private sector and those public organizations pro-active in protecting the environment (for example, Ecofondo and the World Business Council for Sustainable Development in Colombia [Cecodes]).
13. Integrating management practices with environmental issues by introducing new ways and models of organization (for example in the energy sector, road construction and other industries).
14. Increasing the amount of information available about environmental issues and the environment in general. This included founding Sina and promoting research opportunities on specific environmental topics, such as biodiversity.
15. Strengthening environmental education at different levels (in elementary education, high schools, universities, technical colleges, post-graduate studies and adult education).
16. Creating and strengthening programs and projects aimed at promoting the protection of the environment in key industries, particularly during the manufacturing and service stages (for example, environmentally-friendly production programs in the manufacturing industry and large-scale extraction industries, such as mining and hydrocarbon industries. Also, introducing projects which involve using alternative energy and organic agricultural programs.
17. Progress in the development and implementation of projects and programs aimed at conserving strategic ecosystems. For example, national park management projects and projects in indigenous reserves.
18. Developing programs that focus on recovering key ecosystems (for example, the reforestation of micro basins and wetlands and programs focusing on tackling pollution).
19. Placing greater emphasis on environmental programs in urban areas (for example, building water treatment plants, creating the first ever regional sanitary landfill, setting up networks that monitor air quality, introducing cycle routes and the Transmilenio urban bus transport system, recovering and conserving ecosystems in urban areas).
20. Having a high profile role in international talks. For example, Colombia assumed the presidency during talks on Bio-safety Protocol and The Commission for Sustainable Development. Increased international co-operation in terms of technical assistance.
21. Increasing the percentage of the national PIB spent on environmental issues. Setting up systems that guarantee self-financing in environmental management.

Source: Rodriguez B., 2002.

It is not easy to assess the progress made in terms of recovering and improving the environment, while damage to the environment continues. Some observers claim that there are positive examples and approaches which do not deter or reverse processes that lead to the loss of natural resources. But other more optimistic observers consider that Colombia and many other countries are in fact taking constructive and positive steps to create environmentally sustainable societies. Often such improvements in environmental sustainability are to do with the development of more efficient manufacturing processes.



Strengthening the public sector's ability to protect the environment has impacted on the oil palm sector. For example, during the last decade, the oil palm industry has invested in and implemented various projects in order to comply with environmental legislation such as voluntary agreements on cleaner production signed by industry and environmental authorities. The oil palm sector has also updated the Environmental Guide and introduced Environmental Management Plans (EMP). Fedepalma has been proactive in implementing many of these initiatives which has led to a very positive working relationship between the Ministry of the Environment and Autonomous Regional Corporations in Colombia.

In the long term, it is expected that there will be greater regulatory and control measures regarding the protection of the environment in the public sector. This means that greater environmental demands will be placed on the oil palm industry. New environmental legislation and control measures will become stricter and environmental institutions will become more adept at ensuring norms are adhered to. Measures dealing with the banning and control of pesticides will become gradually more restrictive. In addition, in response to international treaties, policy and regulations aimed at halting global climate change, air pollution and water resources will also become more restrictive.

Montecristo swamp - Promociones Agropecuarias Monterrey y Cia. S. en C.

International Environmental Treaties - Implications

The Colombian oil palm industry needs to focus on particular global treaties and other non-legally binding agreements as they have consequences on the agro-industry. In particular, The Convention on Biodiversity, Convention on Climate Change, The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, The Ramsar Convention, The Stockholm Convention on Persistent Organic Pollutants (POPs) and treaties dealing with seas, forests, consumption guidelines and cleaner production. Each treaty aims to tackle a particular problem and or threat, such as global warming or the decline of biodiversities. Environmental systems are intertwined and therefore each treaty has implications on the management of resources, such as biodiversity, water, soils and the atmosphere, as will be shown later.

Multilateral environmental measures and treaties, both legally and non-legally binding, all in various ways affect how the oil palm sector uses renewable natural resources and how the industry tackles conservation and environment management. But first it is important to highlight the following four points: i) agreements are signed between governments and therefore only relate to the signatory states; ii) multilateral ratified and legally binding agreements do not impose direct obligations on state citizens nor private organizations in a particular country; iii) it is expected that governments in order to

fulfill their commitments, will adopt legislation and policies which guarantee that citizens and their organizations are able to effectively contribute to the implementation of ratified treaties. In such a way, international treaties ratified by states affect and will continue to impact on state decisions in relation to environmental regulations and policy; iv) decisions made about the environment by national governments are based on and motivated by ratified international treaties which often go beyond the terms stated in the treaties. In such a way, international treaties impact on society and the manufacturing sectors. International treaties are designed to protect existing ideas about protecting the environment which have consequences on the oil palm sector. Many non-governmental organizations (NGOs) promote campaigns to protect the environment, including conservation programs and environmental codes of conduct. These measures can also be found in many businesses and those companies who are environmentally aware. This chapter focuses on two important issues: cleaner production and green markets.

Treaties Banning and Restricting the Use of Hazardous Pesticides

Banning and restricting the use of hazardous substances in the environment and in the field of public health has been underway for some time but during the last few years has gained priority and impetus. A number of global environmental agreements signed during the last decade have direct consequences on agriculture and the oil palm sector, namely those requiring companies to stop certain manufacturing processes and the use of various chemical compounds as pesticides. Furthermore, as a result of these global environmental agreements, it is important to note that particular pesticides and agricultural products have now disappeared from the market altogether and have been replaced by new agrochemicals and or by biological pest control products.

The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

The treaty, signed in 1988, does not impose any controls regarding the export of hazardous substances. The treaty allows signatory states to decide which substances can be imported and allows countries to claim "prior informed consent" before allowing the import of certain

chemicals included in a special list agreed at the Convention. Of the 31 chemicals on the agreed list, 24 are pesticides. To be included in the list, a chemical must be banned or severely restricted, based on environmental or health reasons by at least two countries located in different regions. If pesticide formulas pose problems according to conditions of use in developing countries, such pesticides can also be included in the list. To summarize, the treaty just allows countries to exchange information regarding hazardous pesticides and enables governments to make informed decisions about whether or not it is appropriate to use known hazardous chemicals and or pesticides (Argawal *et al.* [eds.], 2000th).

Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention, signed in 2001, is a global agreement which involves the future control and banning of 12 lethal organic pollutants. These organic pollutants will continue to be used intensively for the next 43 - 83 years. As a result of the Stockholm Convention, 12 chemicals[1] will be banned in the near future. All of these chemicals are among the 31 agreed substances listed in the PIC Convention and relate to POPs. This means that while chemicals are being banned, developing countries may stop importing them (Argawal *et al.* [eds.], 2000a).

Various agrochemicals have been banned and are no longer available on the market. This is the result of global treaties and where the use of some agrochemicals is not permitted in certain countries because of prior informed consent (PIC) procedures. These control measures are based on and controlled by state laws and are adminis-

[1] The Convention on POPs agreed to ban the following pollutants: aldrin (insecticide), chlordane (insecticide), dieldrin (pesticide), endrin (pesticide and insecticide), heptachlor (pesticide), hexachlorobencene (fungacide and a sub-product of pesticide production), mirex (insecticide and fire retardant), toxaphene (pesticide), PCBs (liquid insulators for transformers and hydraulic fluids; a component of various paints, adhesives and resins),dioxins and furanes (sub-products of organic chloride production and incineration processes). The Convention also agreed to restrict the use of DDT (its use is only authorized in malaria-affected countries. (Argawal *et al.* [eds.], 2000a).

tered by governmental authorities from the environment, health and agriculture and fishing sectors. Business product providers and those who support substitute technologies are also involved. The chemicals included in the above treaties are not used in the oil palm sector. In the future, new chemicals may be included on the POP list and new agreed substances added to the PIC list which bans particular imports into a country.

Biodiversity, Water and Climate Change - Treaties and Agreements

The treaties and agreements referred to below pose many opportunities as well as threats to developments in the Colombian palm sector. In practice, complying with treaties and agreements often means acting beyond state norms. Some treaties and agreements allow the oil palm sector to improve its competitiveness but this is not always related to other legal stipulations, as shown in the potential business opportunities relating to the Convention of Climate Change. Furthermore, the very nature of some agreements has impacted on the public conscience in such a way that often this aspect is more significant than just the mere norms themselves. In such a way, consumer behavior involves examining how and why consumers select and or not select particular products based on environmentally-aware decisions.

Biodiversity

The Treaty on Biodiversity signed in Rio de Janeiro in 1992 came into force two years later. Currently, the Treaty on Biodiversity involves 154 countries. The 1992 Convention defined *biological diversity*, or biodiversity as, "the variety of living organisms from any source, such as land and marine ecosystems and other aquatic ecosystems, including the ecological complexes which make up their parts, wich encompass the diversity within each species and between species and ecosystems" (Unep, 2000). The Treaty on Biodiversity has three main aims: i) the conservation of all forms of biological diversity; ii) the sustainable use of its components; iii) the equal distribution of profits derived from using genetic resources. The first, and to a lesser extent the second aim, directly impact on the decisions made in Colombia regarding the management, conservation and use of agricultural soils.

Colombia boosts a rich diversity of flora and fauna and ecosystems, ranking it the second most biodiverse country in the world (IVH, 1997). The country's rich biodiversity is not only found in its state national parks and forest reserves but also in privately owned land and land owned by communities, including indigenous reserves and collective property rights belonging to Afro-Colombian communities. This means that how citizens and organizations decide to manage land use has a great bearing on whether the first main aims of the Convention on Biological Diversity are met[2].

A flock of birds in the heart of a plantation - Inversiones La Mejorana Ltda.

Decisions made by individuals about land occupation, changes to land and or land use and its resources which go against the first and second aims of the Convention on Biodiversity are also contrary to

[2] Following the Convention on Biodiversity, a national strategy on biodiversity was implemented in Colombia (MMA, 1999) including an action plan (IVH, 1998). The national strategy states, "The overall aim is to reduce biodiversity loss and its causes (such as deforestation caused by crop planting) and to promote the sustainable use of species and ecosystems. Policies and action plans regarding biodiversity focus in general on the issue of biodiversity and agriculture." (Andrade, 2003).

The Autonomous Regional Corporations are involved in implementing the various regional plans and projects. The Von Humboldt Institute, The Sinchi Institute, The Institute of the Pacific and Invemar (which specializes in research on biodiversity) have conducted extensive research, forming the bases of conservation programs. In addition, there have been various projects dealing with international technical assistance, particularly in the areas of conservation and the sustainable use of biodiversity in the Andean Pacific region (already completed) and in the Andean Region, both financed by the World Environmental Fund. A program for the protection of parks, funded by the Dutch government was also implemented in the Pacific region of Colombia. Policy regarding the environment and agriculture is stated in a document entitled, "Environmental Development for Sustainable Agriculture", which between 1998-2002 formed the basis of agricultural policy (MMA, 1998). Environmental and agricultural policy in Colombia takes into account international environmental treaties and obligations and their consequences on agriculture.

Protected areas and plantations - Guaicaramo S.A.

state policies and regulations on conservation and the use of biological biodiversity as determined by the Colombian government. The importance of the Convention on Biodiversity and subsequent decisions adopted by the Conference of States Parties since 1994 regarding the conservation *in situ* of species and ecosystems have particular consequences for the oil palm sector. For example, it is advisable that the oil palm sector, when planning to expand the number of oil palm plantations, takes into account the physiochemical and topographical make up of the biological communities that selected areas of expansion support.

Similarly, decisions made as a result of the Convention on Biodiversity about protecting biodiversities and agroecosystems, in particular agrobiodiversity and soil biodiversity, affect agromanagement in the oil palm industry (Unep, 2000). Agrobiodiversity can be enhanced by good agronomic management. It is also possible to conserve and take advantage of the biodiversity found in organisms and microorganisms in the soil and the interactions which exists between them and their organic and mineral characteristics. The selective conservation and protection of fauna and vegetation associated with crops (commonly known as *maleza,* weeds) can, among other things, be used for pest control. In such a way, the management and conservation of biological soil resources can improve the availability of crop nutrients and promote the efficient use of soils. All of the above ideas have clear economic and ecological benefits. One way this can be met is to recycle organic byproducts such as fiber, rachis, mud, stones, as will be discussed later.

Water

There are no legally binding multilateral global treaties that tackle the issue of fresh water in an integral way. However, The Ramsar Convention on Wetlands is relevant to the oil palm sector. In general, water in terms of its quantity and quality, is considered one of the most serious problems facing many regions, countries and local communities in the future (Ideam, 1998b). There are various declarations and treaties which guarantee access to fresh drinking water and provide basic water purification projects aimed at the most poor populations. For example, this can be seen in the plan of action agreed during the 2002 Summit on Sustainable Development held in Johannesburg (UN, 2002). Similarly, the 1997 Program agreed to combat sea pollution from land-based sources, focusing on water pollution. More recently at the World Forum on Water in March 2003, a variety of agreements were reached focusing on preventing water shortages.

Such global agreements have been implemented due to the increasing demand for clean water in general. As a result, countries like Colombia have adopted more rigorous environmental legislation. For the oil palm sector in the future, this means greater restrictions and higher costs for emitting water pollutants and for using water for irrigation purposes and or industrial processes.

Protected wetlands and forests - Oleaginosas Las Brisas S.A.

The Ramsar Convention on Wetlands of International Importance

The 1975 Ramsar Convention is the oldest treaty dealing with important ecosystem resources worldwide. The treaty focuses on the conservation and sustainable use of wetlands. The term wetlands as defined by the Ramsar Convention includes a broad range of ecosystems[3] each possessing special biological and ecological characteristics which are vital in order to guarantee water supplies, food chains and the cultural needs of neighboring communities (Unep, 1998). Large areas of wetlands have been transformed into agricultural zones and urban areas. Consequences of such changes include: damage to and the extinction of biological resources and ecosystems, changes in the regional use and availability of water and the increasing vulnerability of local populations living near wetland areas who are economically dependent on wetlands.

Fúquene lake, the source of the Suárez river - Sogamoso.

Colombia is a signatory state of the Ramsar Convention. As a result, any decisions made by the private sector to transform ecosystems that go against the treaty's aims, also go against state regulations. For example, if the oil palm industry were to expand the draining of wetlands, this would be clearly seen as going against the terms of the Ramsar Convention and national environmental legislation.

During the last few years, the Ramsar Convention has expanded and become more far reaching. Recent resolutions adopted at the Ramsar Convention show how measures have been expanded and implemented to guarantee the protection of wetlands and their surrounding areas. The following list highlights the most important strate-

[3] "...are wetlands comprising parts of marshes, swamps, peat bogs and other water sources whether natural or man-made, permanent or seasonal, stagnant, running, fresh or salt water, including marine water extensions which at low tide do not exceed 6 meters." (Unep, 1998).

gies: the integral management of water basins which includes wetlands, planning land use around water basins, organizing water resources, including underground water sources and in coastal regions and creating economic incentives for the sustainable use of water and land use. Agricultural activities also become directly affected by the terms of the Ramsar Convention when managing and planning water resources, water basins and surrounding lands.

Wetlands and protected forests - Palmas Oleaginosas Bucarelia S.A.

Oil palm crops can coexist with wetlands providing that there are set planning systems and practices and good regional management, including the management of privately owned land. This is possible by following good practice which allows wetlands to maintain and conserve their characteristic functions and structural make up. When planning water use, it is important to remember that wetlands are fragile and that crop production depends on wetland environments.

Climate Change

The Convention on Climate Change was signed in 1992. The aim of the treaty was, "to stabilize the concentration of gases in the atmosphere which cause the green house effect at levels which prevents hazardous man-made products affecting climate systems" (IPCC, 2001). Developed countries are mostly responsible for the majority of past and current emissions causing the greenhouse effect. In comparison, greenhouse emissions per capita in developing countries are relatively low. But in the future, greenhouse gas emissions in developing countries will increase in line with social and developmental needs. The Convention on Climate Change established a series of common responsibilities for all state member countries and a

In the last decade, concerns about the decline of biodiversities have increased particularly in countries located in the tropics where rich biodiversities are found. In the future, the loss of biological resources may make life support systems vulnerable and pose threats to human food chains

series of additional responsibilities for industrialized nations and economies in transition.

The Kyoto Protocol established a series of concrete agreements aimed at getting developed countries to reduce greenhouse gas emissions and in such a way fulfill their commitments agreed at the Convention on Climate Change. So that measures adopted by industrialized countries are cost effective, the Kyoto Protocol emphasized three main ways to achieve cuts in greenhouse gas emissions, including *clean development mechanisms*. This allows developed and developing countries to obtain emission reduction credit (ERC) certificates. These certificates can be granted by developing countries who run projects designed to reduce gas emissions such as, replacing thermoelectricity with systems that use wind power or by creating carbon dioxide absorption plants (e.g., planting forests).

The Clean Development Mechanism (CDM) allows the palm sector to develop ways with which to reduce methane gas emissions. In

Methane capture and its use - Palmeiras S.A.

particular, this involves getting rid of methane emissions from sewage plants used in the oil palm industry. Methane, which has a heating potential 21 times more powerful than carbon dioxide (EPA, 2003), can be harnessed and used in generating electrical energy. This means that emission reduction credit certificates can be sold internationally and also promotes energy self-sufficiency in industrial plants and the palm sector. Currently, the oil palm sector can harness and use methane in an environmentally sound way, making methane an attractive economic alternative way with which to generate electrical energy. In the future oil palm companies will have to deal with more environmental legislation and policies aimed at reducing methane gas emissions. This may encourage oil palm companies to use methane gas as a source of energy and in turn promote better cost management systems and avoid paying air pollution taxes.

Carbon fixing - Palmeras Santana Ltda.

In the case of oil palm crops, it is important to highlight the idea of "carbon capture" or carbon fixing. Carbon dioxide affects global climate change more than any other gas emission. It can be extracted from the atmosphere by plant photosynthesis to format biomass. As oil palm crops are efficient photosynthesizes and producers of biomass, they are able to play an important role in limiting climate change. Soil can play an important role in "carbon capture". This is due to good oil palm crop management practices allowing much of the self-contained carbon to be deposited in the earth in a fixed way in the form of "organic matter". This organic matter is a colloid which forms stable complex structures in soils. Colloids are highly resistant against biological digestion and avoid (or slow) the release of CO_2 into the atmosphere. Colloids therefore deposit organic waste produced by industrial processes (fiber, rachis, mud, stone and waste water lagoons) in the soil. In such a way, it is possible to meet the aims of the Kyoto Protocol by fixing large amounts of CO_2.

As a result, in the future it may be possible to grow oil palm crops in a way that allows carbon fixing in soil organic matter. Carbon fixing in the oil palm industry can play an important role in controlling and reducing global climate change. Furthermore countries involved in the sale of CO_2 fixing need to be able to negotiate skillfully and successfully with potential buyers and provide adequate scientific research about the real potential oil palm crops may have in reducing CO_2 emissions and keeping CO_2 in the soil.

As international talks about climate change progress, it is evident that agriculture in general can enhance greater international cooperation as countries attempt to adapt to new environmental legislation (Uribe, 2003).

Soil

Soil degradation, Guayuriba basin - Meta.

The deterioration of agricultural land is mainly a local problem. External environmental conditions associated with soil deterioration caused by agricultural use generate little global interest. But sometimes local soil erosion can lead to problems at the regional level.

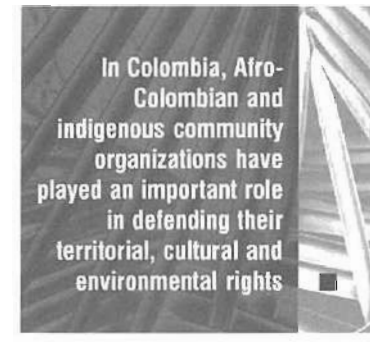
Soil erosion causes desertification and is mostly of anthropogenic origin. The issue of desertification is tackled in the 1994 Convention to Combat Desertification which Colombia ratified. The multilateral Convention to Combat Desertification primarily arose out of the need to combat serious desertification in Africa. But some of the Convention's measures regarding soil loss and desertification are mandatory in Colombia and consequently may also affect the oil palm sector.

Unlike other global natural resources and or environmental issues, such as biological diversity and the atmosphere, the deterioration of agricultural soil affects landowners the most.

Soil management is therefore mainly seen as a national and or local issue. However, as stated earlier, many international treaties dealing with the use and conservation of biological resources, water and the atmosphere, limit or forbid the use of certain agrochemicals. As a result, this has influenced local community-based decisions regarding soil management and use.

International and National Non-governmental Organizations and Ethnic Minority Organizations

Non-governmental organizations (NGOs) have increasingly played an important role in environmental issues both nationally and internationally and have influenced domestic policy and the outcome of international talks. International NGOs have played an important role in countries by applying direct action, as for example managing various field projects or financing local NGO activities.



Also, international bilateral technical assistance has increased. Donating governments are increasingly more likely to work with NGOs because they are deemed to be more efficient. This is in stark contrast to state bureaucracy wich is seen as laborious and often corrupt.

In some cases, international NGO aims have been met by confronting and even reversing existing government and multinational company decisions. For example, this can be seen in the case of Greenpeace and how it has acted and intervened.

In Colombia, various international NGOs have ambitious programs including Conservation International (WWF), The International Union for Conservation of Nature and Tropenbos. A recent census has not been conducted about national NGOs in Colombia. Yet the fact that more than 800 NGOs attended the Environmental Action Fund in mid 2002, aiming to release funds for environmental projects, is a positive.

During recent years, questions have been raised about how representative NGOs really are at international forums and whether NGOs do in fact represent the interests of communities and society in general. As a result, some communities have questioned the actions of NGOs and have asked donating governments that international aid be channeled directly through community-based organizations rather than through the white-collar urban NGOs. Some communities feel that certain NGOs and government institutions often do not adequately represent the interests of donating countries and NGO operating costs negatively impact on investments already made in a project. For example, in Colombia this community-based approach has been carried out with some success among rural community organizations, indigenous reserves and in Afro-Colombian community councils that deal with collective property rights.

In Colombia, Afro-Colombian and indigenous community organizations have played an important role in defending their territorial, cultural and environmental rights. Indigenous reserves in Colombia cover some 28 million hectares of the country's territory and collective property rights belonging to the Afro-Colombian community cover around 3 million hectares across the country. Colombian indigenous and Afro-Colombian organizations operate at the local, regional and even international level. They, like international NGOs, have become increasingly important and influential during multilateral environmental talks in general, as well as continuing to protect traditional cultures. Colombian ethnic minority organizations have played an important international role, influencing decisions made in Colombia. NGO projects or community-based organizations are mainly based in the Tumaco region of Colombia where many oil palm plantations are found. For example, projects financed by Ecofondo[4] as part of the Convention with the Dutch government, support Afro-Colombian community councils. Such councils involve communities who have already been granted collective land titles for lands tradi-

[4] In 1993, Ecofondo was founded by various NGOs and the Colombian government, following a debt exchange program implemented by the US Agency for International Development (AID). Ecofondo currently receives financial support from Holland and Canada and is responsible for selecting NGO projects and deciding which projects should have AID funding. The Ecofondo assembly includes 253 Colombian NGOs.

tionally inhabited by the Afro-Colombian community or who are in the process of obtaining land rights[5].

Afro-Colombian community councils involved in Ecofondo projects tend to view oil palms as foreign species. The oil palm is seen as a crop which is not compatible with mixed farming practices prevalent in Afro-Colombian communities. For these communities, the oil palm crop is not only incompatible from an ecological point of view but also in terms of their ancestral traditions. But some claim that this view is not shared by all regional council members[6]. In comparison with community councils, The Tumaco Cooperation for Agro-business Development (Cordeagropaz), an NGO created to promote strategic alliances between rural organizations, oil palm companies and national, regional and local government, is implementing an ambitious program which involves integrating oil palm crops with traditional farming crops and practices.

1. A meeting of the Cordeagropaz group - Tumaco.
2. Oil palm nursery - Palmas de Tumaco S.A.

But despite diverging opinions about the benefits of oil palm among traditional Afro-Colombian communities, there are many people who claim that a single crop, such as oil palm, damages society and the environment. This view is also shared by various national and international NGOs. The view of Rainforest Alliance, an international NGO, is the most representative. Rainforest Alliance states, "as the number of oil palm plantations increase, so do the negative impacts on the environment and on local communi-

[5] Community-based council projects are funded as part of the agreements made between Ecofondo and the Dutch government. US$3,200,000,000 has been made available for these projects, directly benefiting ten community councils. One of the four aims of the project focuses on maintaining and promoting safe food production, which involves planting 475 hectares of cacao and 100 hectares of coconut plantations using agroforestry systems. Such projects aim to maintain traditional farming methods, including multicrop farming in areas where this has traditionally been practiced (based on an interview with 15 community leaders in Tumaco, March 2003).

[6] Interviews with 15 regional community leaders, March 2003.

Project-based cooperatives - Indupalma S.A.

ties. The problem is not the oil palm tree itself but rather that plantation models are similar to the cultivation of single crops such as eucalyptus and pine. "This can be seen in documented cases from Indonesia, Ecuador, Cameroons and Colombia (Carrere, 2001). However, this view is not shared by all social organizations. For example, there are some rural organizations and NGOs in the Magdalena Medio region of Colombia which promote the cultivation of oil palm as a means with which to construct peace in a region plagued by war and violence.

Lastly, it is important to highlight that current practice favors forging alliances between environmental NGOs, local communities, the manufacturing sector and governments in order to promote projects which benefit the environment and local populations. Such trends can be seen in the Cordeagropaz alliance and in the Johannesburg Conference prompting the oil palm sector to make agreements with different groups and organizations. In addition, current practice favours establishing widely recognized environmental certification programs, similar to the ones which already exist in the field of forestry, among NGOs and community- based organizations.

Cleaner Production and the Development of Green Markets

Intergovernmental treaties and agreements affect both the manufacturing sector and the oil palm industry as discussed earlier. The whole issue of the environment and ways to protect it has become more global in nature. This has created new trends and practices in business and manufacturing which are particularly important in the development of the Colombian oil palm industry. The following section

will discuss the development of cleaner production and green markets. Cleaner production and green markets are intertwined and have recently been developed further in Colombia. Both will play a very important role in the future of the manufacturing sector.

Cleaner Production

The notion of cleaner production and eco-efficiency arose in the late 1980's and early 1990's in response to manufacturing sectors who were having to deal with the increasing importance of the environment in the business world in general (Unep – WBCSD, 1998). Cleaner production is defined as an integral and preventative environmental approach used in manufacturing processes, products and services which aim to reduce costs, encourage innovation and reduce threats to society and the environment.

At the 1992 Earth Summit, following the implementation of Agenda 2, cleaner production (CP) strategies wich promoted sustainable development gained more global importance. Part of Agenda 2 places responsibility on nation states, society and the manufacturing sectors to reduce and eradicate methods of production and consumption deemed unsustainable. As a result, in order to fulfill these aims, a series of strategies will be put into place in the future (Unep, 2001). More recently at the Johannesburg Summit, a plan of action was agreed which involves a ten-year plan aimed at promoting more sustainable means of production and consumption. The nature and terms of the ten-year plan were set out in 2003 and 2004 (UN, 2002).

Cleaner production is an important business strategy promoting sound sustainable development in the following three main areas: competitiveness, environmental conservation and social responsibility. For example, the United Nations Environment Program (Unep) promotes the practice of cleaner production worldwide.

Since 1995, the Colombian Ministry of the Environment has promoted cleaner production as a way with which to control industrial pollution. The idea of cleaner production systems has also formed

part of the country's national policy dealing with the environment in general (MMA, 1997). The government, society and the manufacturing sector must all be committed to environmental policy for it to succeed. All these entities must be involved, mainly because environmental problems have become too complex to be controlled just by direct regulation and also because sustainable development in the manufacturing sector involves confronting new challenges in terms of national and international competitiveness. Environmental management must be seen as a source of opportunity rather than as an obstacle.

One of the main approaches adopted by the Colombian government has been to promote agreements on cleaner production by focusing on environmental authorities and those agricultural and industrial sectors considered most representative across the country. The policy of cleaner production has become a milestone in terms of environmental pollution control. Command and control methods, as stated by law, which are used to prevent environmental pollution are complemented by proactive strategies aimed at improving public and business management. An agreement on cleaner production aimed at controlling pollution and adopting sustainable methods of production was signed by the palm sector under the auspices of Fedepalma. The Ministry for the Environment, Agriculture and Rural Development and the Autonomous Regional Corporations from the departments of Cesar, Magdalena, Nariño, Orinoquia and Santander all signed the agreement which also aimed to promote better public management among the various parties involved (Fedepalma, 1997). During the next 10 years, the signatory members have agreed to develop the following measures:

- Studies which focus on and analyze the oil palm sector in relation to the environment
- Preventative strategies in the manufacturing sector
- Strengthening environmental institutions
- Implementing new environmental laws

- Promoting international cooperation and financial incentives and aid
- Protecting ecosystems
- Monitoring and evaluating progress made in implementing the agreement on cleaner production.

Promoting clean production agreements in the oil palm sector.

In addition to cleaner production strategies, other initiatives and programs relating to environmental management in business, both international and national, have emerged. Though cleaner production systems vary, in general these programs attempt to join those companies involved in cleaner production programs with interested parties, namely customers, financial corporations, shareholders, environmental authorities and the community. These programs promote and share strategies in order to improve production as well as environmental development. Table 1 lists some international and national programs, including their specific aims and scope.

In Colombia, voluentary environmental management programs, such as Florverde and Banatura, emerged to some extent in response to pressures from international NGOs. Some international NGOs accused Colombian producers of poor environmental and social management. As a result, flower and banana growers have initiated and developed environmental management programs that aim to prevent possible financial losses resulting from NGO complaints and to guarantee the competitiveness of these industries. These environmental programs demonstrate the progress the banana and flower growing sectors have made in terms of environmental management (Isaza, Laverde, 2003).

The gradual globalization of markets and greater environmental awareness in general has greatly impacted on the standardization of quality criteria and environmental management. As a result, managing environmental certification, such as ISO 14000, continues to become more important. In January 1998, Tubotech was the first company in Colombia to be granted environmental certification. By mid 2003, some 83 companies from different industrial and agricultural sectors had been granted ISO 14000 certification (Icontec, 2003).

Table 1 National and International Voluentary Environmental Management Programs for Businesses.

Name of Program	Aims of Program	Number and Profile of Members
1985		
Responsible Care[a]	To ensure the responsible management and use of materials and chemicals, in order to protect human health and the environment.	200 business leaders from the chemical sector in Canada. The program was later implemented in 40 countries.
1992		
Global Environmental Management Initiative (Gemi)[b]	To exchange experiences and practices with other international companies in order to promote improvements in the fields of ecological development, worker welfare schemes and risk prevention in industry. The initiative aims to benefit interested parties and improve community relations.	40 multinational company leaders from the food, computer, chemical, oil and transport industries.
1993		
World Business Council for Sustainable Development in Colombia (Cecodes).	To help and encourage companies to adopt practices which promote continual improvement and those practices which aim to achieve a balance between the economic, social and environmental objectives of a company and sustainable development in Colombia.	30 Colombian company directors from a variety of sectors, including mining, oil, agro-industry, manufacturing, construction, commerce and banking.
1994		
Integral Responsibility in Colombia[d]	To provide and strengthen common and consistent practices in areas such as worker welfare schemes, industrial safety and the environment among manufacturers in Colombia. This aims to help businesses achieve their goals and contribute to social progress.	51 company leaders from the Colombian chemical sector.
1995		
The World Business Council for Sustainable Development (WBCSD)[e]	To encourage the idea of leadership as a catalyst for the promotion of eco-efficiency, innovation and social responsibility.	100 business leaders from more than 30 countries and 20 manufacturing sectors.
1996		
Florverde[f]	To promote social and environmental progress by using complementary company strategies based on good practices and consultancy.	145 flower-growing companies from Colombia.
2000		
Banatura[g]	Provide more education and training workshops for banana growers to promote more sustainable banana production.	20 banana-growing companies from the Uraba region in Colombia.

Source: ODES, 2003.

[a] http://www.ccpa.ca/english/who/rc/index.html March 2003
[b] http://www.gemi.org, March 2003
[c] http://www.cecodes.org.co, March 2003
[d] http://www.responsabilidadintegral.org/, March 2003
[e] http://www.wbcsd.org/aboutus/index.htm, March 2003
[f] http://www.colombianflowers.com/esdefault.htm, March 2003
[g] Augura, 2001.

Green Markets

Trade and commerce in general will become important in promoting sustainable green markets, protecting the environment and conserving renewable natural resources. Green markets are largely the result of citizen initiatives designed to guarantee that goods are produced in an environmentally-friendly way. Such citizen initiatives can be seen as part of environmental movements originating from consumer groups in highly developed countries, particularly the United States and Europe. Consumer groups belive that life support systems must by protected from damage caused by manufacturing processes. Green movements are also concerned with food quality, mainly as a result of numerous food scandals and unhealthy products available on the market. Food certification systems have also emerged as a result of consumer awareness and will set the common standards for food quality in the future.

Green products have developed as cleaner production systems have been put into practice. Cleaner production in general should not just be seen as a result of particular new ways of marketing. In addition, green markets are not just about products produced in an environmentally friendly way. In fact, cleaner production regulations and the consumption of environmentally healthier products are part of two environmental movements which emerged as a result of international agreements discussed earlier (IVH, 2000).

Green markets develop in relation to the supply and demand of environmentally-friendly products, commonly known as green products. Green markets and green products in general are the subject of widespread debate, diverse approaches and wide ranging definitions. For example, a recent study conducted in South American countries stated, "Green products in general include a large range of products. The way raw materials have been obtained, the means of production, marketing, consumption and post-consumption are all seen in relation to environmental concerns and consumer views. Green products include those products which contain fewer contaminants and

which are the result of sustainable biodiversity" (FFL-IVH, 2001).

Transporting organic fruit - C.I. El Roble S.A.

Green markets are just starting to develop in Colombia and in the rest of Latin America and the Caribbean. Green markets are examined in relation to their importance in national and international trade and commerce. So far, green markets have great potential and a promising future in Colombia. This is to do with the fact that Colombia has rich biological resources. The country's biological resources can be used to create diverse products and services including, the maintenance of ecosystems and carbon capture, ecotourism, intermediate products (wood, oils, natural dyes, biochemical components and medicinal extracts) and end products (paper, furniture, fuel, body care products and medicine, arts and crafts, fruits, etc.).

Consumers and markets in general identify green products by looking at certification and ecological labeling. Environmental certification allows consumers to see where a product was produced and check whether a product complies with environmentally sustainable and social criteria. Often this can be seen by the label and or seal placed on a product. There are powerful environmental lobbies and movements working towards making national and international certification more credible. This is partly due to the fact that many so-called environmentally friendly products have suddenly appeared on the market. This has caused confusion among consumers as to whether products are truly environmentally-friendly or not.

In addition to ecolabelling, other systems of accreditation have emerged. For example, a business that uses management system standardization programs promotes environmentally-friendly manufacturing processes, as in the case of ISO 14000 discussed earlier. Due to its nature, ISO certification does not involve product labeling. Furthermore, the high prices often associated with green pro-

ducts are to do with the first type of certification rather than the latter. Both types of certification are considered an important requisite for businesses wishing to remain a force in green markets. In the future, industries will need to obtain both types of certification which in practice complement one another.

Some of the most innovative product certification programs in Latin America are: the Forest Stewardship Council (FSC), organic or ecological certification for agricultural and fishing produce, product certification for biodiversity protection, ECO-OK and Green Globe for Eco-tourism (FFL-IVH, 2000).

Environmental labeling among organic agricultural organizations focuses on good soil management and the cleaning of chemical residues from products. The main international agency responsible for granting certification is the International Federation of Organic Agriculture Movements (Ifoam). This organization sets out the basic norms in organic agriculture and gives accreditation to those agencies involved in granting certificates to make sure that certification agencies comply with the general norms established by Ifoam.

Organic agriculture makes up a small percentage of global agricultural production. Yet in 2000, global sales in organic agriculture were valued at roughly US$20 billion and are increasing rapidly, between 10 - 30 per cent each year. Furthermore, organic agriculture has become a very attractive alternative for growers who have seen international market prices fall (FFLA–IVH, 2001).

Organically produced agricultural products form a small percentage of Colombia's total agricultural output. This is true of Latin America and the Caribbean in general. In 1999, Colombian organic agricultural exports rose to around 5 million dollars. In 2002, it was estimated that more than 16,000 hectares were certified or were in the process of obtaining certification. Fourteen Colombian companies certified in organic production export to the United States, Europe and Japan. These companies export a variety of products including, coffee, vegetables, fruit (mainly mangoes and bananas), dried fruits, palm oil, brown sugar, honey, milk, sugar and vinegar derived from sugar (FFLA-IVH, 2001).

Organic oil - C.I. Tequendama S.A.

Two Colombian palm oil companies, C.I. Dabon S.A. and C.I. El Roble S.A, are worth mentioning. Both companies are located in the Northern Zone and together have organic oil palm cultivations covering around 5,000 hectares. Their products are sold exclusively to western European markets, mainly in Germany, England and Holland. Company profits from organic agriculture are around 20 per cent higher than those gained from non-organic oil palm plantations.

Lastly it is important to highlight that in some markets, for example in Andean countries, consumer awareness in terms of food quality and environmentally-friendly foods and products is still not deemed as important as it is in developing countries. Nevertheless, palm oil products should be linked to international market standards. This is because palm oil products are sold to multinational companies and environmental management systems certification plays an important role in integrating production networks. In addition, in Colombia and in other developing countries in general, green markets will grow among those groups in society who have the greatest consumer power.

Conclusion

During the last decade, developments and opportunities in environmental management in the oil palm sector should be seen in relation to the growing importance of environmental issues in general, both nationally and internationally. There have been various multilateral treaties (both legally and non-legally binding) aimed at tackling environmental issues, such as global environmental threats, the deterioration of biodiversities, deforestation, fresh water and sea pollution, global warming, desertification and soil loss. All these impact directly and indirectly on the palm sector's competitiveness:

- In Colombia environmental institutions have been strengthened. This means that the Colombian government has had to become more adept and ensure that industries comply with national environmental legislation which also includes some terms from international treaties ratified by Colombia. It is clear that the implications of such legislation can been seen in the oil palm sector and has led to new government incentives encouraging the sector to comply with environmental laws.

- International environmental treaties and the growth in environmental awareness has meant that consumers and manufacturing sectors have played an important role in positive environmental management. For example, cleaner production and green markets are two ways in which the production of goods, services and product consumption can become more environmentally-friendly. This offers particular challenges and opportunities for the development of the oil palm industry in the future.

- As environmental issues have become more global, multinational and national NGOs have played a more important role in the creation of global and national policy. Often multinational NGOs collaborate with national NGOs and in such a way local NGOs have increased their role in protecting the environment through a

1. A plantation owned by small-scale oil palm growers - Magdalena Medio region.
2. A meeting of small-scale oil palm growers - Magdalena Medio region.
3. Oil palm associations and projects - Tibú, Norte de Santander province.

wide range of activities. Furthermore, ethnic minority and local farmer's organizations, including their national and international counterparts, have increased their influence in terms of defending territorial and cultural rights. Along the Colombian Pacific coast in particular, there are local farmer associations who believe that expanding oil palm plantations using a single crop approach is not socially and or ecologically sound. Such views contrast with other NGOs and farmer organizations who promote the use of oil palm crop across other regions in the country, for example in the Magdalena Medio region. They also consider that oil palm plantations are viable in a multi-crop environment, for example in Colombia's Pacific region. The oil palm industry should take such views into account when formulating its position and strategies regarding the expansion of oil palm plantations. Ecological science research and prevelant social and political views should also be taken into account when planning the expansion of oil palm production.

Environmental Management - Origins, Current Practices and Trends

CHAPTER 2

Sewage treatment systems - Unipalma S.A.

his chapter discusses current practices and trends in environmental management and its impact on the oil palm sector. The following analysis is based on general research about environmental management and uses data obtained from surveys conducted with oil palm companies.

Business Surveys

In December 2002, a survey targeting managers of oil palm companies was conducted in order to evaluate how environmental management is used and carried out in oil palm companies. The survey focused on the extent to which managers felt environmental management was important in their companies. The second part of the survey dealt with how managers view current practices in environmental management and future challenges facing the oil palm plantations including land use, biodiversity, fertilizer use, pest control and water use and supply. Finally, the survey focused on other environmental management issues in oil palm mills such as resource management, including the use of raw materials, energy, water and subproducts, environmental management systems and the implementation of prevention strategies.

The survey was sent to a total of 50 companies. Thirty-one companies replied, representing a 70 per cent feedback. As a result, only some trends can be highlighted and it is not possible to reach comprehensive conclusions about how oil palm companies as a whole perceive environmental management now and in the future.

Environmental Management - Background

Environmental management in the oil palm sector is a fairly new feature. In general, it can be seen as a response to a number of factors which gained force during the early 1990's, following the Earth Summit. These issues include: environmental regulations, greater pressure from national governments and their increasing ability to enforce legislation, the views and demands of external markets and the search for more efficient ways to process raw materials and use waste products and subproducts.

Positive changes in environmental management in oil palm mills, are linked to the demands placed on mills by environmental authorities, particularly after the implementation of Law 99 in 1993. Progress in the environmental management of plantations has developed mainly due to the need to find dynamic ways to tackle specific environmental issues. These issues include, tackling weeds, diseases and pests, and to a lesser degree, water shortages and soil fertility.

Field research in Palmar de La Vizcaína - Cenipalma.

Progress made in environmental management in the oil palm sector is linked, in particular, to research and technological developments. Despite the fact that oil palm plantations started to develop in Colombia around 45 years ago, it is only during the last 11 years that there has been a sustained effort to further research and technological development, as the founding of Cenipalma in 1991 shows (Fedepalma, 2001). The development of Cenipalma and the creation of Fedepalma's Environmental Unit are both part of this positive process of transition moving towards proactive and creative environmental management. Results of these processes show economic and social benefits.

Management of Biodiversity

Despite progress made in environmental management, it is widely acknowledged that many of the problems facing the oil palm industry are linked o the complex biological characteristics, regional topographies and climates where oil palm plantations are located. This section discusses the affects of oil palm production on biodiversity, soil and water and the ways in which these issues have been tackled.

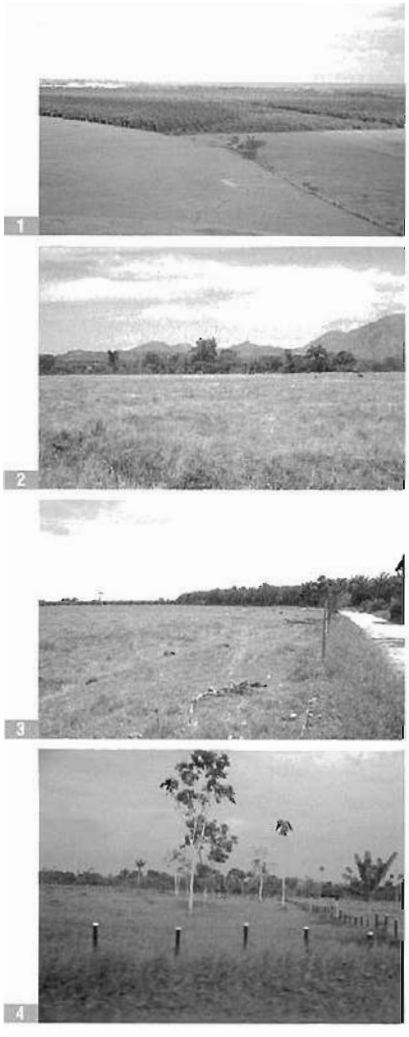
Establishing Existing Plantations and Transforming Natural Ecosystems

The impact of oil palm farming on biodiversities is a controversial issue, both in Colombia and abroad. The growth of oil palm plantations has impacted negatively on global biodiversity, in particular in areas where rainforests have been cut down, as for example in Malaysia, Indonesia, and Ecuador (Dodson and Gentry, 1991; Lim, 1994).

In Colombia, fewer areas of natural forest have been cut down to make way for palm plantations in comparison to those countries mentioned above. However, as Colombia is one of the planet's most biodiverse countries, any activity that may destroy this patrimony of national and world interest deserves careful national and international scrutiny by state organization and NGOs. As oil palm production expands, the issue of protecting biodiversities needs to be even more carefully examined and monitored by the oil palm sector in general.

In Colombia, oil palm plantations are found mainly on those lands that were once used for cattle raising and agriculture, spread across four palm growing areas, also known as zones. In addition, some land that is now used for oil palm production was in the past areas of natural forests. Results from the survey show that 82.5 per cent of the areas where there are now oil palm plantations were once devoted to cattle raising and or agriculture and that 17.5 per cent of the land contained natural ecosystems.

In some areas, there has been concern about the loss of natural forests as a result of oil palm farming. For example, Tumaco is a dense oil

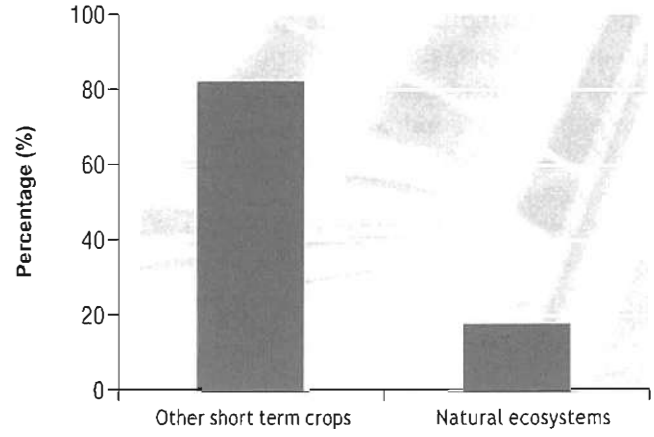


Changes in soil use to make way for palms.
1. East Zone
2. North Zone
3. Central Zone
4. West Zone

palm growing area, representing 13.7 per cent of the total national area where oil palm is grown and is known as a hotspot in terms of global biodiversity. It has been claimed that in Tumaco and its surroundings, areas of natural forest were cut down to make way for oil palm plantations. Yet according to data from the survey, most oil palm crops were in fact introduced in lands previously used for cattle raising. More research still needs to be carried out to determine what proportion of areas currently used for oil palm production were in the past forest ecosystems and or used for cattle raising (see Graph 1).

The case of Tumaco and the ensuing national and international debate, shows the importance of biodiversity issues. Furthermore, various studies show the negative impact of oil palm production on those local populations who once inhabited lands where palm oil is now produced. Other social and economic problems resulting from the development of oil palm industries have also arisen (UNDP, 2003). However, these are issues that go beyond the aims and scope of the research and analysis contained in this book.

According to the national report on human development *El conflicto callejón con salida*, 2003, "The Conflict, A Way Out of the Impasse", oil palm plantations are part of the so-called Colombian enclave economies which include the banana industry in Urabá, oil exploration particularly in Arauca and Casanare, coal mining in La Guajira and gold mining in Chocó, south Bolívar and other regions. Enclave economies are characterized by, "a marked tension between the accumulation of capital and social exclusion and the fact that many investors do not have strong links in the areas where enclave economies are located and therefore tend not to reinvest their profits in those areas" (PNUD, 2003).



Graph 1 Changes in land use to make way for palm plantations

Source: Fedepalma/Odes survey, 2003.

In the past, the creation of large-scale oil palm plantations has often led to the displacement of small farmers and indigenous groups from lands they have traditionally inhabited. This has been documented in various countries with negative impacts on society. But at the same time, the creation of large-scale oil palm plantations, as for example in Malaysia, have led to new social structures and ways of social organization which have helped to solve problems such as poverty and social disintegration. In Colombia, projects along these lines have been set up in existing oil palm plantations. There are also plans to develop farmer associations and reinsert former rebel fighters as employees in some oil palm companies. The overall aim is that new types of oil palm companies may be able to contribute to peace building and help eradicate poverty (from an interview with Arturo Infante, 2003).The above examples highlight why in some cases there are concerns about the impact of large-scale oil palm plantations on society and the environment, particularly in the Tumaco region. However, it is important to note there are no known recent cases where natural ecosystems have been destroyed to make way for oil palm plantations.

The oil palm sector has taken important steps in reaching and defining a policy which promotes biodiversity conservation. The *Guía ambiental para el subsector de la Agroindustria de la Palma de Aceite*, "An Environmental Guide for the Oil Palm Industry," developed join-

tly by the oil palm industry and the Ministry of the Environment, states that, "in areas of special strategic importance, such as primary forest relicts, lowland forest areas, gallery forests, wetlands and areas where moriche palms are found, such areas should be protected..." (Fedepalma, MMA and SAC, 2002). Such policies are steps in the right direction. As a result, it is right to be optimistic about the future of natural ecosystems still found in the oil palm plantations of those companies surveyed. According to the survey, natural ecosystems account for 15.7 per cent of the total area of oil palm plantations (15,600 hectares).

However, not all oil palm plantations and companies are committed to biodiversity conservation to the same extent. Visits to plantations reveal that in some companies the protection of forests and forest restoration is considered a feasible option whereas in other companies forest conservation is seen as less of a priority. The survey conducted supports this view. When companies were asked about the criteria

Protected areas:
1. Palmas de Tumaco S.A.
2. Oleaginosas San Marcos Ltda.

used when selecting areas where not to plant palm trees, 36 per cent of companies stated close to water sources or running water, 28 per cent sloppy areas, 27 per cent areas which used to be covered by forest and 9 per cent in areas which may increase income-yield capacity.

Environmental Management in Oil Palm Plantations

Replacing short-cycle crops and cattle farming with growing oil palm is considered by some in the oil sector as a positive feature in the development of the oil palm industry in Colombia. This view takes into account the different ways short-cycle crops and cattle farming impacts on natural ecosystems in comparison with oil palm plantations. This view is shared by a number of authors who emphasize the positive ecological characteristics of the oil palm crop in comparison to short-cycle crops and cattle raising (Abraham, 1992). Nonetheless, cultivating oil palm crops can present problems in terms of biodiversity conservation. This is because expanding monoculture-based farming systems can actually exacerbate pest control problems; an issue which has been widely documented. There are concerns that due to the rich biodiversities of insects found in the tropics and the recent introduction of oil palm crop in some areas, new pest formations will pose problems exacerbated by pesticide use and extensive monoculture farming (Andrade, 2003; Motta-Valencia, 1999).

1. Annual plantations - Zulia river valley.
2. Cattle raising - Sogamoso river valley.

A new trend in the Colombian oil palm sector is using oil palm crops in the long term to help biodiversity management in monoculture farming, as well as using oil palm crops as an efficient measure against pest control. This involves strengthening farming ecosystems and using these ecosystems as tools in integrated pest management (IPM) and disease management. Examples of such practices include (Aldana, 2002):

- Planting species, especially leguminous prostrate plants, which are used to get rid of weeds and help protect the soil.
- Planting beneficial plants which attract natural predators.
- Allowing parts of weed overgrowth to grow naturally in and outside of the plantation.

1. Beneficial plants - Manuelita S.A.
2. Pruning palms - Palmas de Casanare S.A.

In addition, there are two other types of practices which enrich soils and promote soil biodiversity conservation. For example, the use of compost from vegetable by-products (rachis, fibers and pruned leaves) which are used in general by the oil palm sector as natural fertilizers and the use of sludge and treated effluents as fertilizers. Such methods not only help to reduce the use of agrochemicals but have countless environmental benefits, in terms of the soil, biodiversity, the atmosphere, water and human health.

As part of integrated pest management systems, there has been a gradual shift from using a wide range of pesticides towards using particular biocides. Furthermore, management practices which limit pest expansion have been introduced. This includes the control of spontaneous palms, which promote pest succession (Aldana, Calvache, 2002). It is also important to note that large quantities of biomass are produced when oil palm trees are restored (those with an average life span of 25 years) which involves using different systems of management in order to prevent plagues of insects developing (Aldana, Pallares, 2000).

Improvements in the use of fertilizers in the oil palm industry have helped to promote greater tolerance and resilience against pests and diseases. Foliar and soil analyses have also allowed the oil palm industry to examine nutrient levels in plantations and also which fertilizers should be used in plantations. As a result, foliar and soil analy-

ses in general have reduced the need to use pesticides and have promoted integrated pest management systems, including plant nutrition and managing the use of fertilizers. This can especially be seen in the oil palm growing regions in the north of the country (known as the Northern Zone) where organic farming practices have replaced the use of agrochemicals.

1

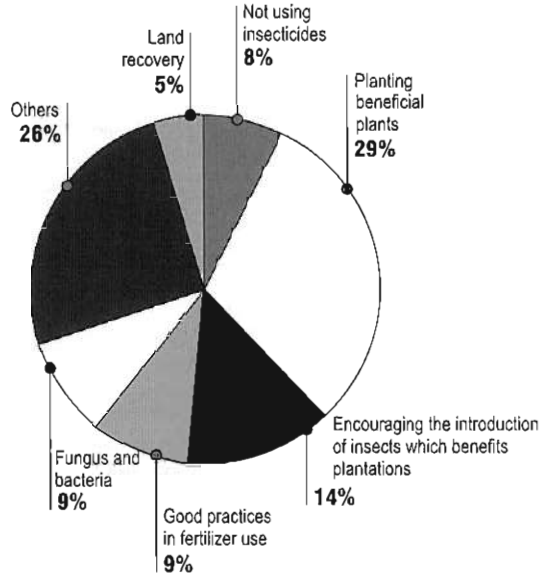

2

1. Organic fertilize plant - C.I. Tequendama S.A.
2. A biological products laboratory - Palmar del Oriente S.A.

As research published by Cenipalma shows, the Colombian oil palm sector has made important progress in the field of biological pest control. The difficulties in using chemical controls are reflected in the survey results. According to the survey, 13 of the 27 companies stated that they were trying to only use biological controls against pests. The survey also shows that a large number of companies are using biological controls, which is significant considering the complex nature of using biological controls in extensive areas where monoculture farming is used (Aldana, 2002) (Graph 2).

Soil and Water Management - Trends and Developments

A salient feature of the Colombian palm sector is the diverse climates and soils in where oil palm crops are grown. Oil palm plantations are found in areas which receive over 4,000 mm of annual rainfall and also in areas where rainfall is less than 1,000 mm (Romero *et al.*, 1999). Another salient feature is that climatic diversities lead to edaphic diversities. In areas where there is greater rainfall, soil tends to be more acidic with less phosphorous and cationic nutrient content. In drier areas, soil tends to be less acidic and has more basic nutrients (Brady, 1974). These edaphic differences impact on plant nutrition management practices and also how weeds, organic waste, beneficial plants, plant coverings and pest and disease control are managed.



Graph 2 Different types of integrated pest management systems used in the Colombian oil palm sector

Source: Fedepalma and Odes, 2003.

As Uribe (2003) indicates, "climatic and edaphic differences means that there is not a homogeneous technological system which can be applied to all crops and oil palm plantation management systems in general. Appropriate technologies and soil management practices should be developed according to each particular area and adapted gradually. As technological processes are adapted, it is clear that within the four main palm growing areas (North, East, West and Central) there are climatic and even social and economic differences. Management systems therefore need to be adapted according the local environment and particular local soil management practices and techniques."

Environmental Soil Management and the Environment

Research about soils has only been conducted recently and is less comprehensive than existing research about integral pest management systems. The experience of the French, Dutch, English colonial-

ists in Africa in terms of pest control and management systems, appears to have influenced practices in the past in Colombia. More recently, new technological developments in soil fertility developed in Malaysia, have been used in designing land management strategies in Colombia (Chan 1981, 1982a, 1982b).

As discussed before, soil management is an agronomic issue that should be planned and designed locally. Soil management depends on the specific local interactions taking place between agricultural systems, including: i) physicochemical properties of soils; ii) local climate; iii) the nature of the crop. In order to design soil and water management practices, it is essential to understand these interactions.

However, in Colombia, soil management is not based on this type of data. Instead, theoretical approximations in general are used when making decisions about soil management. This has various implications, including:

- Using fertilizers efficiently is important when bearing in mind that money spent on fertilizers can account for 50 per cent of maintenance costs in plantations that are over three years-old. Decisions about soil management, such as which types of nutrients to use (organic byproducts and or fertilizers) and when and how often to apply nutrients, is generally based on information which has not been obtained locally. Economic and environmental costs can be limited if locally relevant scientific data on soil management, particularly plant nutrition, is used. Moreover, using and relying more on local scientific data can make a difference in terms of the palm sector's international competitiveness.

- The lack of local scientific data makes it difficult to make sound decisions. In other words, in terms of the environment and plantation costs, the absence of specific scientific data about the various edaphic and climatic conditions, makes it impossible to know which soil management practices and or a combination of theses different practices can lead to optimum production systems. In addition, due to the lack of local scientific data, it is impossible to know to what extent current soil management practices reach their optimum levels.

Organic fertilizer trials - Palmeras de Puerto Wilches S.A.

As a result, poor local scientific data can have negative economic and environmental effects.

Promoting soil research programs at Cenipalma is an important strategic development and can help answer many issues regarding soil fertility management, promote environmentally-friendly production processes and increase income-yield capacity and competitiveness in the oil palm sector.

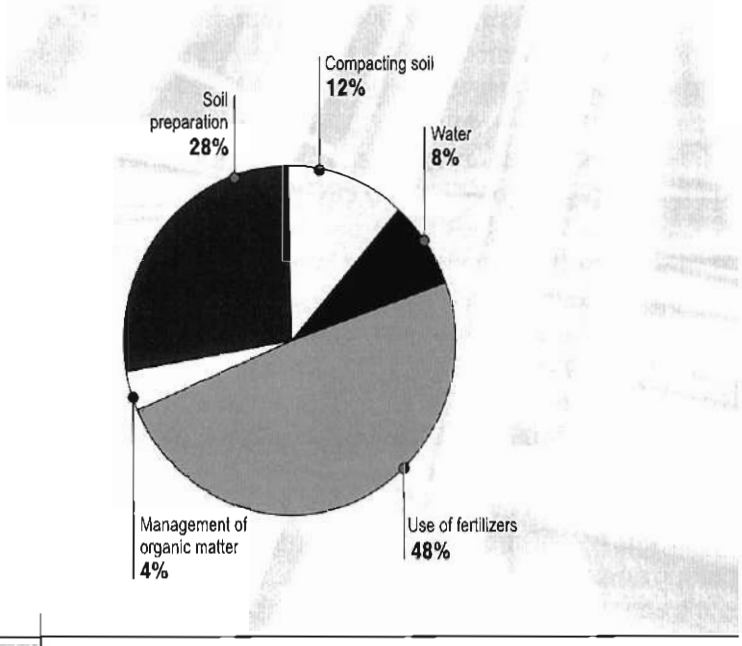
Trends in Soil Management

Soil management, particularly soil fertility, is an important issue for palm growers. A survey conducted as part of this book's research reveals two important issues regarding soil management i) there is a great need and interest in improving soil management practices; ii) there is a need to clarify which are the best soil management practices in the future.

An analysis of the survey shows the importance of soil management among palm growers. About 22 per cent of palm growers surveyed consider that the use of fertilizers is the most important issue that impacts on the environment. This is surprising considering that there is no conclusive evidence that shows that the current use of fertilizers in oil palm plantations leads to environmental problems.

According to the survey, 50 per cent of palm growers said that the most important issue regarding soil management is the use of fertilizers. The survey also revealed that decisions about fertilizer use (such as which type of fertilizer to use, dosage and frequency of use) are based on various sources, including international trade magazines, advice from oil palm federations and other palm growers, soil and foliar analyses and personal experience. It is important to note that a significant number of palm growers, 21 per cent, base their decisions about the use of fertilizers using land analyses and 27 per cent of palm growers refer to foliar analyses. These results show that decisions about soil management are based on scientific evidence. However, in Colombia, decisions made about soil management reveal basic weaknesses. Due to the lack of local specific data, palm growers often refer to international research and data to interpret foliar and soil analyses, without reference to the local environment where palm is grown. To interpret foliar and soil analyses properly, it is important to refer to and understand the area from where soil analyses were originally conducted. This is because the behavior of nutrients found in the soil, the "critical levels" and a crop's nutritional needs varies according to the climate and edaphic conditions in each region and the type of crop being grown. All these factors can affect soil management in general (Graph 3).

The survey also revealed that there are great differences in the amount of fertilizer used. The amount of fertilizer used ranges from 0-1000 kg per hectare each year. Thirty two per cent of palm growers reported that the amount of fertilizer used can exceed 1000 kg per year. As a result, the development of long-term research at Cenipalma focusing on soil management and soil nutrition is important, particularly when considering that fertilizer costs make up a high percentage of the budget. In general, Cenipalma needs to focus on research that examines developing soil fertility management strategies which are economically and environmentally efficient. This involves identifying the different types of soil management practices used in each area and applying organic



Graph 3 The main concerns companies have about soil management

Source: Fedepalma and Odes survey, 2003.

waste from production processes to soils. Such measures can help raise production levels, while keeping costs down and limiting damage to the environment.

It is important to note that wise soil management practices are employed in the majority of plantations. These practices include using industrial farming byproducts (rachis, fiber, ashes, fruit stones, etc.) and applying sludge from sewage treatment lakes (Conill, 2000). The benefits of these types of practices have been documented globally (Lord, 2002; Primavessi, 1997). Plantations who adopt these types of practices use less fertilizer and some plantations have stopped using chemical fertilizers altogether.

Such practices not only save on fertilizer costs but have important global implications. Firstly, they help to preserve soil biodiversity and richness. Secondly, they allow carbon contained in the biomass to be converted into organic soil matter and not be emitted into the atmosphere. As discussed earlier, this could be an important factor when negotiating

Applying fiber on palm crops - Oleaginosas San Marcos Ltda.

financial compensations for signatory states of international treaties on climate change.

Water Management

In the oil palm sector, as in all types of farming, water is considered a non-renewable resource. In Colombia, the availability of water and its distribution varies greatly between regions. In some regions, water is scarce and in other areas there is plenty. Such differences in water supply impact on soil management practices, plant coverings, pests and diseases.

Water supply impacts on soil fertility. In general, in areas where rainfall is high, the soil tends to be more acidic and has greater levels of soluble aluminum, iron and magnesium. In this type of soil, phosphorous present in the soil and phosphorous substances introduced into the soil by fertilizers and soil amendments, react with iron and aluminum oxides to form low soluble compounds not found naturally in plants. In general, nutrients such as calcium, magnesium and potassium are normally found in low concentrations in soils and are not commonly found in plants.

Water irrigation management - Hacienda La Cabaña S.A.

As a result, in regions where there is a sufficient water supply due to high rainfall, it is important to develop soil management practices which promote soil fertility and make efficient use of soil nutrients which can be scarce. Soil management practices should be developed following extensive research and should examine:

- Nutrient use according to particular soils and regional climates which produce optimum production levels
- Appropriate nutrient sources (residual and organic waste, fertilizers, corrective elements and combinations of them) for particular soils and climates
- When to apply nutrients to particular soils and how often to apply soil nutrients
- Soil management systems which reduce nutrient loss by leaching and reducing phosphorous fixation

Canals used for irrigation - Rio Aracataca.

- The effects of dosage, type and source of organic waste on the soil acidity and nutrient levels.

In one oil palm growing region, known as the Northern Zone, there are water shortages due to seasonal rainfall which can last for long periods of time. In this region, problems associated with soil acidity and phosphorous fixation are less of a concern. Normally in soils with high nutrient levels, water can temporarily limit the amount of nutrients absorbed by plants and biomass production. If soil fertility and the use of nutrients are to be used to their full potential, either as organic matter and or soil amendments and fertilizers, irrigation systems must be developed as a way of controlling the negative affects water has on the amount of nutrients which plants can absorb.

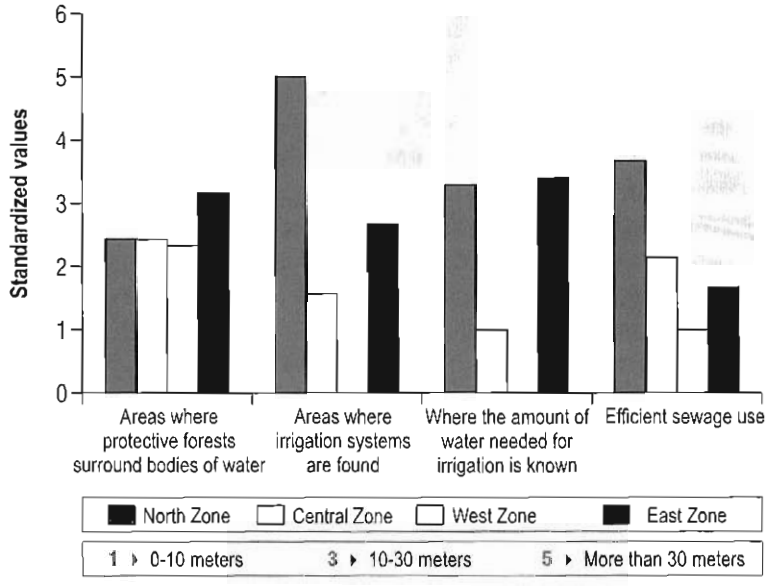
Where water supply is scarce and or variable, decisions about soil fertility management should take into account rainfall patterns and the development of irrigation systems. How plants absorb nutrients, whether introduced into the soil or occurring naturally in the soil, depends on the water supply.

Trends in Water Management

According to the survey, most palm growers consider that water management is the greatest environmental problem facing plantations. The differences in water supply across regions, means that crop management systems also vary.

In the North Zone, water management is concerned with tackling water shortages during the so-called "summer" months. In the West Zone, water management focuses on irrigating surplus water using drainage systems. Graph 4 shows how the differences in water supply across regions affect water use.

Graph 4, starting from the left side of the graph, shows the standardized results in meters within a defined zone made up of protective forests which are found near rivers, streams and creeks running through plantations. These types of land zones are important in terms of water control, protecting biological corridors and maintaining stable margins of vegetation near bodies of water. In Graph 4, 1 refers to inter-



Graph 4 Water resource management in plantations including regional variations (using a scale of 1-5)

Source: Fedepalma and Odes survey, 2003.

vals of 0-10 meters, 3 refers to intervals of 10-30 meters and 5 refers to more than 30 meters. The standardized intervals show that these land zones, made up of protective forests, tend to be larger in the East Zone than in other areas.

The graph shows where and to what extent irrigation systems are used in plantations (5= irrigation systems are used, 1 = no irrigation systems are used). According to the graph, many plantations in the North Zone have irrigation systems, while in the Central Zone there are none. The survey revealed that many plantation managers would like to be better informed about the amount of water used per hectare and the way water is used in plantations in general. Also, 30 per cent of plantation managers would like to receive information about how much water is needed for crops to achieve optimum production levels. In addition, almost all of those surveyed said they would like be better informed about government policies, water access rights and conservation strategies. The survey also highlights the need to improve links between the government and oil palm growers.

The use of effluents from water sewage treatment plants and how they benefit soil fertility was also examined. Good practice involves using water from sewage treatment plants on palm crops so that water can be used more efficiently. Using water in such a way helps to reduce water shortages and more importantly avoids sewage from mills, which contains residual amounts of organic matter, traces of oil and nutrients being emitted into bodies of water and or running water. In Graph 4, number 5 means that effluents from water sewage treatment plants are used for soil fertility, number 1 means non-use. Using effluents from water sewage

Water sewage treated used in plantations:
1. Palmeras de Alamosa Ltda.
2. Aceites S.A.

Recovery, protection and management of rivers - Río Tucurinca (Sierra Nevada de Santa Marta).

treatment plants is more common in the East, North and Central Zone and less common in the West Zone.

It is also important to highlight that applying water from sewage treatment plants on soils also brings about other benefits, such as nutrient levels and the prevention of sewage.

Graph 4 reveals that water management is more advanced and developed in the North Zone in comparison with other zones. Water shortages in the North Zone have shown that water management is critical in terms of the palm sector's competitiveness. As a result, Fedepalma, in collaboration with the union for banana growers and Metro Agua S.A., are leading a project in the Santa Marta region that involves the recovery, protection and management of fifteen streams and creaks. This project is a private sector initiative which has the backing of regional and national authorities and is considered to be of strategic importance in the future.

These examples show that water management is considered an important issue. According to the survey, 90 per cent of palm managers said that they were willing to partly fund the development of private initiatives which aim to protect hydrographic basins used by oil palm companies.

Environmental Management in Oil Palm Mills

As in plantations, the issue of environmental management in oil palm mills gained force after 1992. The development of good environmental management practices in oil palm mills have largely developed in response to national environmental policy and legislation. Environmental management has also developed due to the demands of environmental authorities and society in general. According to the survey, over 75 per cent of oil palm companies consider that environmental authorities are the main external factors influencing environmental managements in mills. In some cases, as seen in the Central Zone, complaints from the local community forced oil palm companies to reduce sewage from mills into bodies of water.

According to the survey, managers of environmental management programs and production managers consider water pollution as the main environmental issue resulting from oil palm production, followed by managing subproducts and welfare programs for employees. The results of the survey show that often issues such as sewage from mills and organic waste are seen more as problems rather than as opportunities and are not seen as an integral part of the way a company attempts to become more efficient and increase profits.

Sewage Management

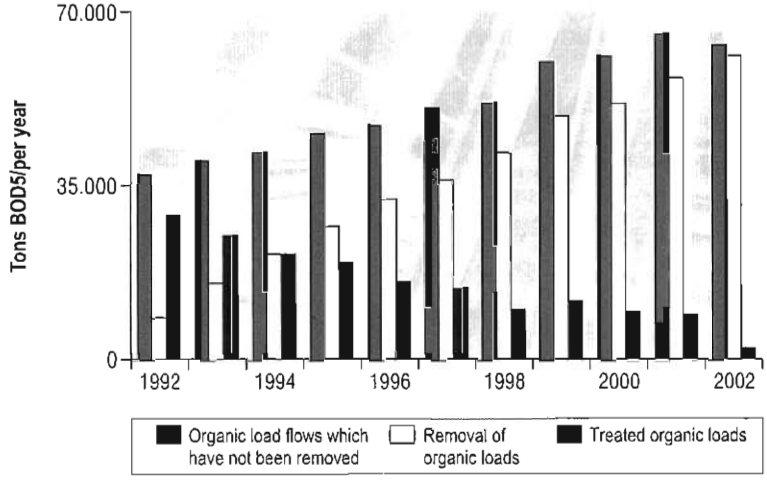
Sewage management - Agropecuaria La Loma Ltda.

The oil palm sector focuses on water pollution as part of its environmental management. Before 1992, the oil palm sector discharged high quantities of sewage with high levels of organic matter into water. This affected water quality and led to the loss of aquatic life, eutrophication and odors.

Currently, over 99 per cent of mills have sewage systems in comparison to just 6 per cent of mills in 1992. At the moment, mills can remove more than 95 per cent of sewage organic load and, in such a way, oil palm companies are complying with current environmental norms. (BOD5; < 1000 mg/l, DQO: < 2000 mg/l, ST < 600 mg/l, grease and oil < 75 mg/l, pH < > 5 -8, T < 45°C). The impact of environmental measures implemented by oil palm mills can be seen in Graph 5. The graph shows that positive changes have been made in a short space of time and marks significant progress in environmental management across the Colombian oil palm sector.

Most mills were built after 1995 and their efficiency is related to the amount of pollution tax each pays. Since 2002, proportional tax rates have been relatively low, each company paying around an average of 300,000 pesos (US$125) every six months (Mazorra, 2003).

Thus in ten years, the issue of water pollution has gone from being the oil palm sector's most serious environmental problem to an issue that has now been tackled. But although sewage problems are less of an issue, more than 50 per cent of mills still pour treated effluents into bodies of water. In doing so, mills fail to take advantage of the water's nutritional properties and their benefits when applied on crops. Some



Graph 5 The development of organic loads
(The oil palm sector as a whole per year)

Source: Fedepalma and Odes, 2003.

mills use treated water and recycle it and use its cooling properties as a way of enhancing the removal process of effluents.

Capturing water - Inversiones La Mejorana Ltda.

Until recently, prevention measures dealing with water use in mills have not been a priority. This may be due to the relative low amounts of water used (around 0.85 m^3 of water used per ton of fresh fruit processed) and because of cheap water prices. It is expected that the price of water will increase in the short and medium term while financial incentives and proportional tax rates are gradually implemented. As a result, proactive management systems focusing on improving more efficient water use, both on crops and in mills needs to be deve-loped further.

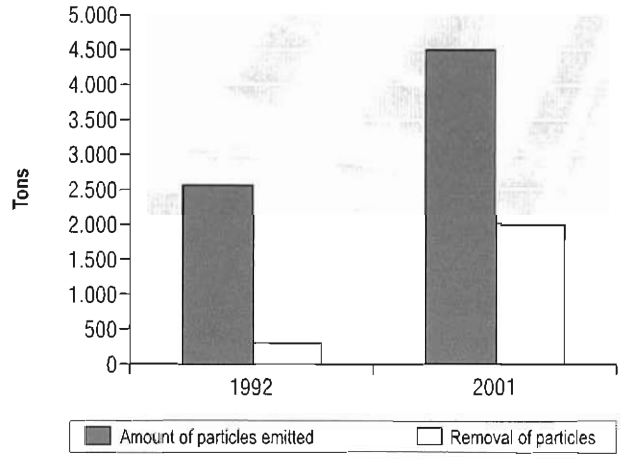
Air Pollution

Air pollution in the oil palm sector became an issue in the mid-1990's mainly due to pollution emitted into the atmosphere from boilers and the burning of husks in open fields. As a result, oil palm companies gradually did away with burning husks in open fields as they began to realize the value of using husks as fertilizers. In addition, currently around 20 mills have built centrifuges that remove particles. As Graph 6 shows, managers of oil palm mills still need to go further in addressing the problem of particle emissions.

In order to comply with legislation dealing with air emissions, the oil palm sector has generally focused on making end-of-pipe[1] changes which means additional costs.

In addition to focusing on end-of-pipe solutions[1], another option is to make combustion processes in boilers more efficient. This helps mills

[1] End-of-pipe solution - a way of treating existing water pollution.



Graph 6 Particle emissions per year
(Includes the oil palm sector as a whole)

Source: Fedepalma and Odes survey, 2003.

to comply with air emission regulations, improve a mill's overall efficiency and income-yield capacity.

Some oil palm companies believe that the problem of air pollution is related to the inefficient combustion of fibers and fruit husks in boilers. According to the survey, there is still a great deal to be done about improving efficient energy management systems. Only 50 per cent of the companies surveyed regularly conduct energy audits. The survey also revealed that 85 per cent of companies consider that cogeneration is a possible option, about 70 per cent of companies believe that cogeneration reduces costs and 25 per cent believe that cogeneration leads to the efficient use and management of subproducts. The

Controlling air emissions - Aceites S.A.

results of the survey highlight that better use of energy from subproducts is an important issue which needs to be developed further in the oil palm sector.

Management of Byproducts

Using byproducts, including bunches, fibers, seeds and sludge from sewage treatment, as fertilizers in plantations and as sources of combustion in boilers enhances production processes in mills and is beneficial for oil palm crops in general.

Despite the fact that using byproducts in this way is widely known across the sector, significant challenges still exist in optimizing and expanding their use. There are big differences in the methods used across the oil palm sector, especially how husks and sludge from oxidation ponds are used. Some companies only use byproducts found in soils near mills so as not to incur further transport costs. But such practices ignore the important nutrient values found in byproducts. In

Methane gas capture and use - Guaicaramo S.A.

contrast, other mills particularly in the North and West Zones, are introducing composting which can later be used as fertilizer. In some mills, waste such as boiler ash, is also used. But in most cases, boiler ash is deposited in landfills even though the ash is high in potassium which could be very useful for plantations (Suárez, 2002).

Using methane gas released from sewage water treatment ponds as a fuel for electric generators, is another example of the way byproducts are used in the oil palm sector. Currently two companies are involved in the use and fixing of methane. Since 1994, a company in the West Zone has been using a biogas reactor. Also since 2000, another company in the same zone is using a covered pond to fix methane. Both companies report that fixing methane has reduced their diesel fuel costs by 50 per cent (Conil, 2000). In the East Zone, two companies are currently in the process of covering their methanogenic ponds. As methane gas emissions are one of the main causes of global warming, eliminating methane emissions across the oil palm sector has a significant positive impact on the environment. Including reducing methane emissions in Emission Reduction Certificates (ERC), which were created following the Clean Development Mechanisms developed as part of the Kyoto Protocol on Climate Change, would greatly benefit oil palm companies.

Environmental Management Systems

The oil palm industry has made significant progress in environmental management, both in mills and in plantations. This has been possible due to the research Cenipalma has been carrying out since 1992. Sharing good practice at regional and national oil palm committees, in particular focusing on technological developments and technical assistance, has also promoted environmental management in general. Since late 2002, the fact that all oil palm companies who own mills have submitted their environmental management plans to the Regional Autonomous Corporations for approval, shows the progress made in environmental management across the sector (Mazorra, 2003).

But there are only a few oil palm companies who in practice regard environmental management as an integral part of their business. For example, two companies in the North Zone managing more than 5000 hectares of certified organic crops, are employing good environmental

Water management and use - C.I. Tequendama S.A.

management practices. This helps to reduce production costs and allow companies to earn greater profits due to the higher prices that organic products generally tend to fetch in the market.

For some oil palm companies who manage mills, environmental management is perceived as a strategy that helps businesses comply with environmental legislation. These companies tend to implement specific environmental projects when the need arises. However, new trends in environmental management have been developing, such as the environmental management plans. The Environmental Guide, produced by the Ministry of the Environment, was created to promote the use and development of environmental management plans, particularly in farming and animal husbandry. Research shows that further progress is needed in the exchange of information regarding environmental management among the oil palm sector in general. Also, it is important to promote the use and development of the Environmental Guide, particularly in farming and animal husbandry.

The main recommendations discussed in the next chapter, focus on the challenges of making the whole issue of environmental management a key integral feature of oil palm sector in general.

Conclusion

The chapter's main conclusions are:

- During the last decade, there has been significant progress made in environmental management in both oil palm farming and in mills.
- Environmental challenges facing the oil palm sector have been in general generally solved in a heterogeneous way. Particular progress has been made in reducing water pollution, integral pest management and reducing the amount of pesticides used. But there are still improvements to be made in reducing air pollution.
- Some companies see environmental management as a problem, while others see it as an opportunity. In general, environmental management in the future should be dealt with in a more formalized and structured way.
- Company data and information about the oil palm sector in general needs to be collected more efficiently and computerized so that it is possible to monitor environmental performance more easily.
- At first the issue of environmental management for many companies was a response to new environmental regulations and institutions. But gradually more companies view environmental issues as commercial opportunities that can actually enhance their competitive edge.
- The sector has adopted a proactive approach in terms of environmental management. For example, the founding of Cenipalma and Fedepalma's Environmental Unit. The unit's role is to co-ordinate, guide, advise and promote environmental management in the palm sector as a whole.
- Biodiversity is an important issue for the oil palm sector and even more so in Colombia, as it is the second most biodiverse country in the world. But the impact of the oil palm industry on biodiversities is debatable. In fact, it is questionable whether damage to biodiver-

sities as a result of oil palm farming is even a legitimate and justifiable concern. However, it is important to take into account the views of very influential interest groups who campaign for the protection of biodiversities. In general, the Colombian oil palm industry will be assessed to the extent it pursues environmentally-friendly policies and whether the country's natural ecosystems are threatened and damaged as a result of the oil palm industry.

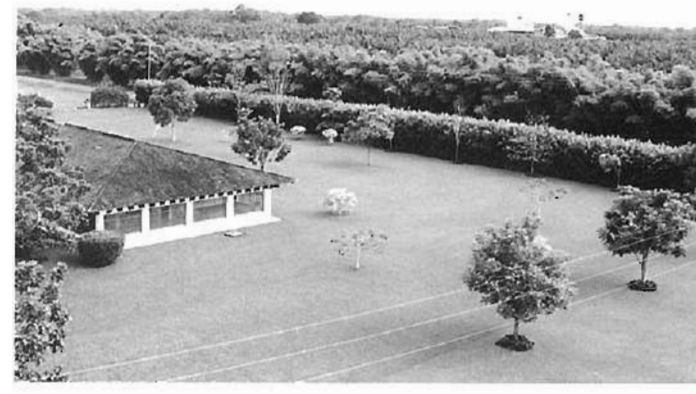
- New more environmentally-friendly practices have been introduced which have impacted positively on biodiversities. But pest control in monoculture farming still remains a concern.

Protected areas - Hacienda la Cabaña S.A.

This chapter will discuss environmental management in the oil palm sector in the short, medium and long term. Emphasis will be placed on the opportunities environmental management presents and the threats that international competitors, such as palm growers from Malaysia, Indonesia and other Latin American countries, pose on the Colombian palm industry. Reference will be made to the oil palm industry's strategic vision for 2020.

Environmental Management in Plantations

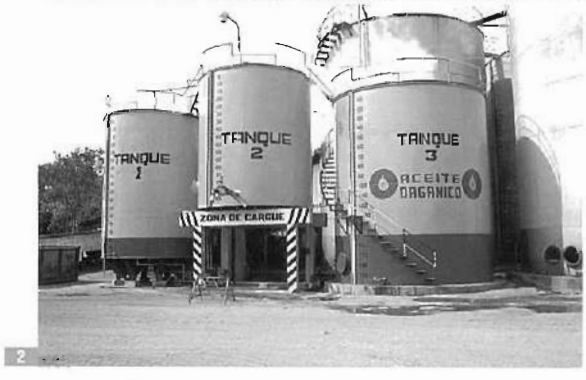
To enhance the oil palm industry's competitiveness, good environmental practice and systems should be reinforced and expanded throughout the whole sector. Evidence shown in Chapter 2, highlights the potential benefits of good practices applied in some plantations and emphasizes that if these practices are reinforced and expanded, environmental performance across the sector can improve.



Environmentally-friendly management of surrounding areas - Manuelita S.A.

Secondary Forests and Oil Palm Cultivations

According to Andrade (2003), palm cultivations may contribute to creating ecosystems with the same characteristics found in secondary forests. In such a way, oil palm growing can be considered a type of agroforestry (Gómez, 2000). In contrast with traditional practices which have favored maintaining plantations like gardens, the selected growth of weeds and beneficial plants in plantations is encouraged as an efficient strategy against pest control and improving soil fertility. Forest undergrowth in palm growing areas, which were originally forest areas, also needs to be promoted.



1. Managing beneficial plants
   Palmas Oleaginosas - Bucarelia S.A.
2. Organic oil - C.I. El Roble S.A.

By definition, organic farming is environmentally-friendly. The growth of organic palm farming in Colombia depends on the response from Fedepalma, palm growers and owners and whether there is an increased market demand for organic products. The government will also play a role in developing organic palm farming in the future and needs to encourage market research in this area and establish conditions that favor its expansion. Organic production systems can be expanded and updated in dry regions with good fertile soils and in areas less prone to diseases. This in turn helps to increased productivity levels.

Multi-crop farming should be encouraged and financial incentives introduced. There are good examples of multi-crop farming in Colombian oil palm plantations, such as the small-scale palm growers in the Tumaco region. This farming practice involves different types of agriculture such as cocoa, plantain, trees used for timber, coconut palms, oil palms, fruit trees, animal husbandry and uses forest relicts found

in the palm plantations. In such a way, oil palm cultivations complement other types of agriculture. Multi-crop farming allows traditional ways of farming which are environmentally-friendly to continue and can protect small farmers against price fluctuations in the market.

Best Practices in Soil Management

Many oil palm plantations in Colombia have adopted, to varying degrees, processes and practices that positively contribute to the development of environmental sustainability in the palm sector. Oil palm crops adapt easily to different soils and respond well to organic fertilizers which can help plantations to become more environmentally-friendly. Using organic fertilizers improves soil sustainability, both in physical, chemical, and biological terms, while limiting soil degradation (León Gómez, s.f.; Uribe, 2003). Also, using byproducts from plantations as organic fertilizers in soils, promotes environmental sustainability and helps to close production cycles.

Sharing good practices - Manuelita S.A.

In order to promote the above good practices, it is necessary to make the following improvements:

- Identify good soil management use and practices in each palm growing zone. This includes examining soil flexibility and to what extent good soil management practices can be quickly transferred and adapted to other regions with low economic and agronomic risks.

- Good soil management practices with environmental and agronomic benefits need to be selected and monitored.

- Promote ways of disseminating information to palm growers across the country about good soil management practices and how these


1


2


3


4

5

practices benefit the environment and agroneconomy.

- Assess and monitor soil management practices to allow existing soil management practices to be adapted to each region's particular climatic, social and edaphic features.

Soil use and management practices which have agronomic and economic benefits are:

- Introducing rachis and bunches to soil around plants. This practice increases the levels of organic matter in soil and in such a way improves the soils physical properties, biological activities and nutrient content. It also promotes efficient water use and helps to maintain soil moisture around plants for longer periods of time, particularly in areas where there are seasonal water shortages.

- Applying boiler ash on soils. Ash is comprised of highly-concentrated nutrients and allows nutrients in the soil to be re-used. This measure can reduce production costs and the need to use chemical fertilizers.

- Applying fiber produced in mills on soils. This practice can be used when fiber is not the energy source of oil extraction plants or due to greater boiler efficiency, surplus fiber is produced. Recycling materials back into

1. Applying bunches - Palmeras El Morichal Ltda.
2. Applying fiber - Palmeiras S.A.
3. Sludge management - Palmar Santa Elena Ltda.
4. Managing plant coverage - Astorga S.A.
5. Organic fertilizer - Aceites S.A.

the soil, like bunches, has two main advantages. Firstly, the organic matter content of the soil increases and secondly, recycling nutrients back into the soil reduces the need to use fertilizers.

- Applying sludge and sewage from oxidation lagoons which are used to treat sewage emitted from extraction plants on soils. Sludge and effluents have high levels of nutrient content and organic matter which help to improve the soil's physical properties and biological activity.

- Keeping the soil covered with prostrate plants. This common practice helps to enrich soils biologically and nutritionally and increases biological productivity in the soil in general. This is because prostrate plants create favorable microclimatic conditions in the soil, encouraging microfauna and microflora to develop. In turn, this increases the amount and availability of nitrogen for palm oil plants and other organisms.

- Using fertilizer in the right way, including the correct dosage while taking into account the seasons and appropriate amount of time to apply fertilizers. Reference to foliar and soil analyses, the local climate and topography are also important.

Good Water Management Practices

Developing ways to process organic waste can improve the efficient use of water use and improve soil nutrient content levels. For example, applying waste produced from mills on soils, such as bunches and fiber is one way of improving soil water retention. This in turn prevents water evaporation.

In order to obtain maximum efficient use of soil fertility and scarce water resources, coordinated management systems that oversee nutrient and water use are essential. Determining the exact nature of good water management practices which optimize nutrient productivity and which are environmentally-friendly, involves long-term research that examines:

- Which types of products should be applied to the soil, such as organic byproducts and or fertilizers. This also involves taking into account the particular type of soil and climate of each region.

A reservoir - Montecarmelo S.A.

- Efficient irrigation systems which promote good water use and nutrient management, including nutrients that are applied to the soil and or occur naturally in soils.

- How, when and how much organic waste and fertilizer to use on soils in order to promote greater efficiency in water use and soil nutrients.

The issue of good water management use and conserving water supplies in the long-term is crucial. This is particularly important in areas where there are seasonal water shortages and where irrigation systems are used. In addition, it is important to take into account water basins and use them to analyze water management and use. To do this involves the participation and commitment of a whole range of regional civic and government institutions working together in a co-coordinated way.

Good management of water basins and forests ensures a regular water supply. In oil palm plantations located in the Northern Zone, a

clear correlation exists between the success of an oil palm company in the future and how water basins and forests at low and medium altitudes are managed and conserved. Water management practices which do not promote the conservation of water basins in the long-term can damage a region's water supply. If this happens, there will be greater fluctuations in the supply of water during the year. For example, during the "summer" months, water supplies could decrease and in "winter," excess flows of water could threaten the safety of communities living along riverbanks and plantations located nearby.

Restoring and managing water basins - Sierra Nevada de Santa Marta.

Rainfall patterns, water levels in soils and the relative humidity of air, all play a very important role in pest and disease management of oil palm crops. In general, as air humidity increases, the risk of pathogen attacks and their severity also increases. Therefore irrigation systems are not only important in terms of water and nutrient management measures but also affect pest management. In general, when designing and adapting irrigation systems, their impact on water and nutrient availability and pest and disease control should be taken into account.

Pest Management

Integral Pest Management (IPM) across the oil palm sector has become more widespread and is seen as an alternative to using biological controls. IPM has environmental and economic benefits and needs to be encouraged in the palm sector.

IPM is also a system that leads to good management of ecosystems. It is well known that a biological balance needs to be maintained

Managing beneficial plants - Promociones Agropecuarias Monterrey.

between predators and herbivores in tropical farming ecosystems. In addition, it is important to conserve and encourage the presence of natural predators in oil palm plantations (Fee, Sharma, s.f.) (Valencia, 1999). Indeed many of these species make up part of the natural habitats where oil palm crops grow. In addition, good management of beneficial and prostrate plants helps to increase the numbers of defoliating insects (Aldana, Calvache, 2002). This can be achieved by planting and maintaining native vegetation or prostrate plants, as seen in the case of *Osiphanes cassinna* (Lepidoptera) (Calvache *et al.*, 1998). In some parts of the world, owls are also used as rodent controls.

As Andrade (2003) highlights, ecosystem management in general can be difficult. Often oil palm plantations are located in jungle areas, as for example in Asia. Here important groups of species, including major vertebrates and flora are often considered as pests in oil palm plantations. In Colombia, anthills (ants of the genus *Paratrechina*), cause problems as they suck insects and "crazy ants" introduced into the farming ecosystem have also caused pest problems (Aldana, 2000).

The presence of natural pollinators in oil palm plantations is an important issue and should be the subject of further research. It has

been documented that natural pollinators can adversely affect rates of reproduction. These issues are more complex than just the usual predator-prey, pollinator-plant relationships and go beyond farming ecosystems in general. In fact, these issues form part of regional ecosystems.

Oil Palm Expansion and its Impact on Biodiversity

It is important to examine those areas which have been singled out for future oil palm expansion in order to limit the impact on biodiversities and to ensure the conservation of natural ecosystems.

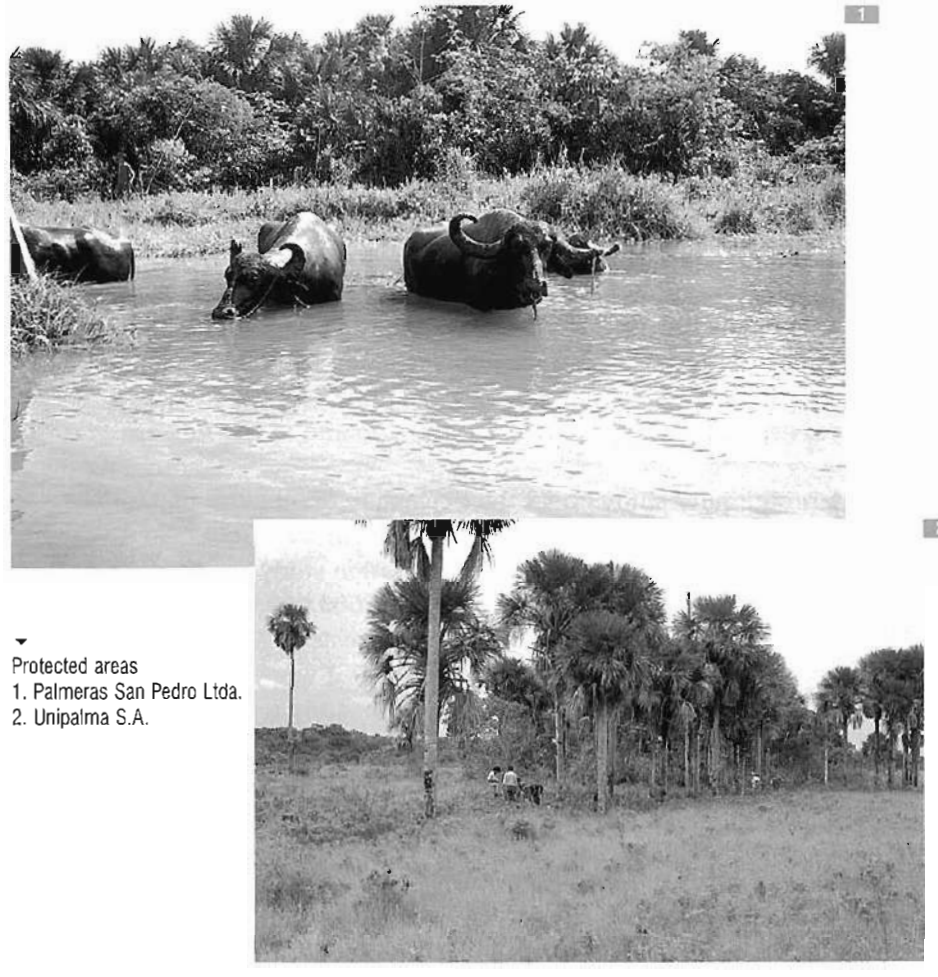
As Andrade (2003) states, "the main way in which oil palm cultivations can be considered to be positive in terms of biodiversity is when the development and expansion of oil palm plantations does not adversely affect natural ecosystems, especially those found in tropical forests."

Although the Colombian palm sector has committed itself to conserving ecosystems and their biological resources, not all palm growers consider biodiversity conversation to be important during manufacturing processes. For example, isolated incidents of deforestation to make way for small-scale oil palm plantations, may still be occurring especially in the province of Nariño and in the Eastern Plains.

A preliminary study about the expansion of oil palm plantations has been made based on limited information available. The following results are based on a land use evaluation study conducted by Cenipalma and Corpoica, using a scale of 1:500,000 to assess soil quality and local climate. Areas of, "natural forests in the Colombian Amazon and the Pacific" (Romero *et al.*, 1999) were not included in the study on biodiversity conservation. The study revealed that by 2020, it is expected that the number of oil palm growing hectares will increase by 250,000 – 750,000 hectares. In terms of expanding oil palm production in Colombia, there are 3,531,844 hectares where oil palm plantations may be built without any existing restrictions, 6,133,381 hectares of possible palm growing lands with moderate restrictions placed on them and 23,032,885 hectares of land with severe restrictions. In conclusion, "the study represents real progress made, partic-

ularly when bearing in mind that biodiversity conservation is still not considered an important factor when evaluating potential land uses (Igac, Corpoica, 2002). However, excluding the forest areas of the Amazon and the Pacific regions of Colombia, does not mean that future of oil palm expansion will not be a factor in biodiversity loss" (Andrade, 2003).

At first glance, introducing oil palm plantations on lands that are currently used for farming and animal husbandry does not seem to present any problems. Comparing maps produced by Corpoica and Cenipalma (1999) with a general map showing Colombia's ecosystems, reveals that in most of the areas where there are no existing



Protected areas
1. Palmeras San Pedro Ltda.
2. Unipalma S.A.

restrictions for the expansion of oil palm plantations there is no natural plant coverage (on the macro-scale in general). But the study reveals weaknesses. Firstly, a more comprehensive study needs to be carried out, including improvements in planning scales and using a scale of 1:500,000. Also, further field visits and studies need to be conducted and more environmental restrictions included in studies that analyze potential new oil palm growing areas.

The main way in which oil palm cultivations can be considered to be positive in terms of biodiversity is when the development and expansion of oil palm plantations does not adversely affect natural ecosystems, especially those found in tropical forests

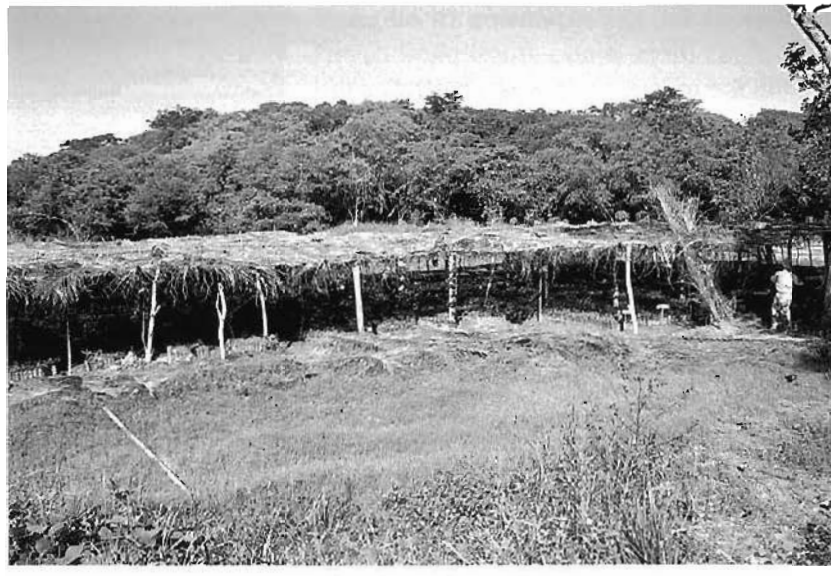
The study revealed that oil palm plantations should not be allowed in areas covered by natural forests, especially gallery forests in the Eastern Plains and Upper Guaviare region, Nariño, and Cauca. Also, possible oil palm expansion in the natural savannahs located in the departments of Casanare and Meta (especially if these are relictual savannahs), as found in the Caribbean region (Cesar), needs to be carefully examined. In dry tropical forest areas, namely areas with moderate restrictions or with no restrictions, are characterized by relicts of dry tropical forest areas and areas which are transforming into semi-deciduous forest areas. Both these types of areas are extremely important because their relictual biodiversity is at risk.

According to Andrade (2003), the following regions need to be examined in more detail:

- In the department of Meta, there are "no restriction" areas along the Duda and Lozada Rivers (west of the Macarena Mountain Range) but these areas on the ecological map show areas of natural coverage of, "floodplain forests of the Andean white rivers," some of which are found near the Tinigua national park.

- The gallery forest areas surrounding the Metica River, where it is claimed there is still significant natural forest coverage. On ecological maps, these areas are marked as a possible oil palm growing area with "no restrictions".

- A large area in the Pacific region, between the departments of Cauca and Nariño. According to ecological maps these areas have important expanses of natural forest with "no restrictions".



A palm nursery and protected areas - C.I. Tequendama S.A.

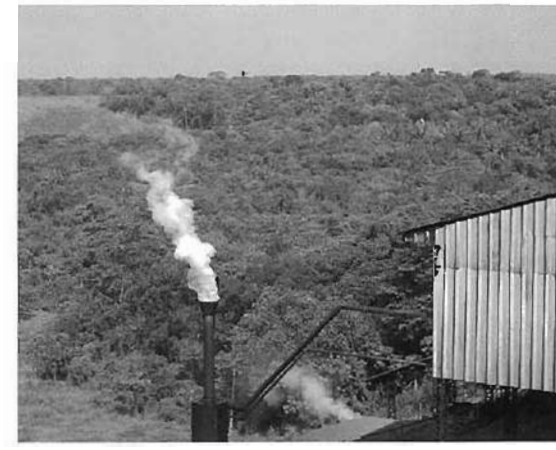
- Areas with "moderate restrictions" may include areas of natural alluvial forests (which have been partially damaged) located south of Catatumbo in the department of Northern Santander and relicts of dry tropical forest which are one of the most threatened ecosystems in the Americas (Álvarez *et al.*, 1998) especially in the departments of Magdalena and Córdoba.

- Despite the fact that the majority of Colombia's biodiversities are found in forest ecosystems, different types of natural open vegetations, savannahs, are also important in terms of biodiversity and should be examined (Etter, 1998). Some of the areas classified as "no restriction" zones include areas of natural savannah ecosystems, as for example in Arauca (non-floodable savannahs in the Eastern Plains).

A Closer Look at Impacts on the Environment Due to Oil Palm Expansion

It is important to examine in more detail the environmental impacts that future palm plantations may have in areas singled out for expansion. This requires not only looking at biodiversity protection, including soils, but also natural vegetation relicts and forest ecosys-

tems which need to be recovered. In addition, water cycles, erosion control, the capture of CO_2 and conserving the surrounding environment also need to be examined. Also particular emphasis needs to be placed on protecting and recovering areas of natural vegetation relicts which are important for the palm sector. The above ideas are promoted in the *Guía ambiental del subsector de la Agroindustria de la palma de aceite – An Environmental Guide for the Oil Palm Farming Industry* (Fedepalma, MMA, SAC, 2002).



Protected areas - Entrepalmas S.A.

Protecting natural vegetation relicts promotes biological pest control as natural barriers are created. It also promotes the conservation of fauna and flora and micro-basins which help maintain water supplies. According to the palm growers surveyed, maintaining good water supplies was the most important environmental issue facing plantation managers in all areas, expect Tumaco. Furthermore, the survey revealed that palm growers were willing to collaborate with each in order to protect upstream hydrographic water basins. In practice, this means developing natural plant coverage in areas where oil palm farming is planned.

Limiting the environmental impact of future oil palm plantations also involves reaching new agreements between palm growers and local and central government. Also, greater emphasis needs to be placed on outlining how government agencies can contribute to the protection and recovery of natural ecosystem relicts. Finally, the Colombian government can play an important role by setting up economic incentives that favor environmental conservation, including the introduction of tax incentives.

Making oil palm plantations more environmentally-friendly involves implementing various schemes, both in individual plantations and

1. Protecting micro water basins - Oleaginosas Santana Ltda.
2. The recovery and management of the Sevilla river - Sierra Nevada de Santa Marta.
3. Protected areas of moriche palms - Sapuga S.A.

at the sub-regional level. As Andrade states, "a good starting point with which to enhance the ecological structures needed for sustainable management in farming ecosystems is to focus on groups of relicts and natural areas. In addition, it is important to enhance environmental heterogeneity and improve the ecological features of existing and future oil palm growing areas. The ideal approach would be to combine oil palm plantations which have adopted various farming practices with areas devoted to forestry development and ecological restoration, for example, biological conservation corridors, protector-producer forests or forests which solely protect hydrographic basins. In other words, the idea is to enrich ecological structures by diversifying oil palm farming ecosystems".

As a result, it is recommended that Fedepalma adopt the core features of *Ecological Infrastructure* (EI) as a long-term goal. This involves implementing the above recommendations within a structured framework. EI is discussed further in Annex 2.

Environmental Management in Oil Palm Mills - Views and Challenges

The future challenge in terms of environmental management in mills is reaching "zero emissions." The idea of "zero emissions"[1] implies recycling and using all the byproducts produced during manufactur-

[1] The oil palm industry in Malaysia is aiming for "zero emissions" (DEO, 2000).

ing processes. This promotes greater harmony with the environment and maximizes the oil palm crops income-capacity yield, which in turn allows palm plantations to be more competitive (see Annex 3).

In comparison to other agricultural crops that are used in vegetable oil production, the oil palm has a very favorable energy balance. The income yield-capacity of a crop is directly related to its energy balance, which is defined as the relationship between the energy required to produce the crop and the energy released when products and byproducts are used. Word and Corley (1991) point to an input/output relationship with an energy value of 9.5, compared to relationships of 2.8 for corn and 2.5 for soya. Attaining "zero emissions" means that an even greater energy balance yield can be achieved because oil palm biomass is incorporated and recycled. Graph 7 shows a conceptual model of a mill's mass and energy balance rates that may be used in the future to optimize energy balance rates.

Input

		Unit	% Masic	Energy value (Gj)
Fresh Fruit	1000	kg	53.39	0.8915
Water	873	kg	46.61	
Energy used to process				1.2145
Total	1873	kg	100.00	2.106

Oil Palm Mill

Input

		Unit	% Masic	Energy value (Gj)
Oil	255	kg	12.01	7.7205
Water (nuts-14 kg, bunches-152 kg, sludge-266 kg, water-15 kg-water-74 kg)	1221	kg		
Nut (19 kg solid nuts, 34 kg oil nuts)	53	kg	2.83	1.3855
Bunches (152 kg of water, 82 kg of solids, < 1 kg of oil) *	82	kg	4.38	1.148
Bunches (water - 152 kg 82 kg solid, < 1 kg oil)*	100	kg	5.34	
Sludge (24 kg solid, 4 kg oil)	28	kg	1.49	
Fruit stones (57 kg solids, 1 kg oil)	58	kg	3.10	
Fiber (97 kg solids, 9 kg oil)	106	kg	5.66	
Total	1873	kg	35	10.255

*Includes the energy of sludge, fruit stones and fiber.

Graph 7 Matter and energy balance in an oil palm mill

Source: "Industrial processes and the Environment", *Handbook No. 3* (1999) y Wood, *The Energy Balance of Oil Palm Cultivation* (1991).

In theory, if all the byproducts are used properly, the input/output energy relationship is 9.5. This rate varies if the recycling of byproducts is not taken into account, as shown in Graph 7. The challenge is to get near the input/output energy relationship of 9.5. by optimizing energy use of waste and by adopting efficient environmental management practices.

"Zero Emissions" and Cleaner Production

In order to meet the challenge of "zero emi-ssions", Colombian palm companies must be more *proactive*. In practice, this means implementing changes which go beyond than just complying with environmental legislation. In order to promote cleaner production as an environmental strategy it needs to form part of the challenge of achieving "zero emissions".

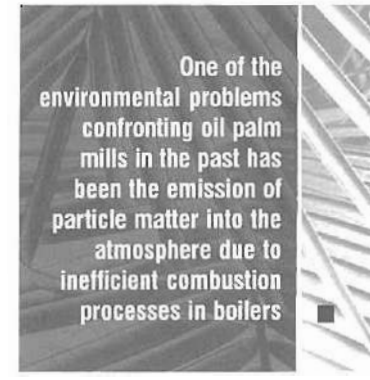
The future challenge in terms of environmental management in oil palm mills is reaching "zero emissions." The idea of "zero emissions" implies recycling and using all the byproducts produced during manufacturing processes. This promotes greater harmony with the environment and maximizes the oil palm crops income-capacity yield, which in turn allows palm plantations to be more competitive

One of the environmental problems confronting oil palm mills in the past has been the emission of particle matter into the atmosphere due to inefficient combustion processes in boilers. To tackle this problem, different alternatives have been used such as the introduction of end-of-pipe solutions in boiler chimes, as well as other preventive solutions. These cleaner production alternatives should be seen as part of a continuous process of improvement that each company strives towards.

Improving cleaner production processes as a prevention strategy in mills involves the following:

- Limiting waste production from the source by improving the plant's manufacturing processes and systems of control
- The recovery and efficient use of byproducts

- Water and sewage recycling
- Improving water treatment methods.



One of the environmental problems confronting oil palm mills in the past has been the emission of particle matter into the atmosphere due to inefficient combustion processes in boilers

A key issue in environmental management in the oil palm sector is using prevention strategies that tackle water flow which can also help improve extraction processes in general. Good water management includes the following: controlling water use in manufacturing and cleaning processes, controlling temperatures during the filtering process and oil leaks, the design of grease traps, separating rainwater from sewage and finally good storage systems for solid materials (bunches, fibers, fruit stones) in a plant. Implementing these measures will reduce air pollution and make extraction processes more efficient. An example of standard good practice is $0.7m^3$ of water used per ton of processed fruit.[2]

Air emissions are caused by inefficient combustion processes in boilers. The challenge for companies when implementing cleaner production strategies is to first optimize combustion processes in boilers rather than implementing other types of measures to reduce air emissions. The extent to which combustion procedures can be improved depends largely on the type and age of a boiler. In the case of obsolete boilers, any changes would involve a significant financial investment. Table 3 identifies the ways in which combustion processes in boilers can be stabilized and optimized (DEO, 2002).

Attaining "zero emissions" in the future also involves the efficient use of byproducts which in turn increases their value. This involves finding new ways to promote efficient water use and transform waste into byproducts, such as fuel and fertilizers. In general, striving towards "zero emission" contributes to the competitiveness of the oil palm sector and helps the industry meets international standards. Table 3 shows examples of good environmental management practices which attempt to solve the main environmental problems facing the palm sector.

[2] $0.7m^3$ of water per tonne of fruits refers to standards used in Malaysia. The Colombian palm oil sector needs to define which standards are more appropriate for use in Colombia.

Table 3 Good Environmental Management Practices

Alternative methods	Inefficient practices	Good practices
Water pollution		
Efficient water use	Poor cleaning practices, in particular closing valves	▮ Supervising machine operators ▮ Use of valves that close automatically ("pistols")
	Tank overflows, especially in the pressing and clarification processes	▮ Installing level sensors in all water and oil tanks ▮ Training for machine operators in control measures
	Unnecessary cleaning due to oil leaks	▮ Preventive maintenance practices for equipment and transport systems (especially in the press) ▮ Training for machine operators in control measures ▮ On-going inspection of machine operators
	Leaks in water pipes	▮ Preventive maintenance of water transport systems
	Using water to remove oil and solid materials when cleaning	▮ Removing dry oil prior to using water in cleaning processes ▮ Removal dry solid materials prior to applying water in cleaning processes
	Poor use of hydro-whirlwind cyclones.	▮ Training for machine operators
Temperature control during the filtering process	High oil content (> 1%) in sewage during the clarification process stage	▮ Installing thermometers in clarification tanks ▮ Temperature inspection (always > 90°C) in clarification tanks by operators
Design and use of grease traps	High oil content in sewage (> 6000 mg/l)	▮ Installing grease traps in mills (condensed from the sterilization and filtering processes) to allow grease and oil to be separated more efficiently at temperatures of 80-90° C
Separating rain water and water coming from drainage process systems	Diluting sewage waste with rain water leads to poor water treatment systems	▮ Covering drainage systems under the roof of a mill ▮ Collecting rain water from the roof of a mill and from areas where extraction processes take place. This measure helps to avoid the dilution of sewage
Separating collected solid materials	Drainage channels become blocked with solid materials	▮ Introducing separate areas to keep bunches, fibers, fruit stones and ashes ▮ Training workshops for operators about using machines properly

Table 3 Continuation

Alternative methods	Inefficient practices	Good practices
Air pollution		
Optimizing combustion processes in boilers	Inefficient combustion due to boilers which are not fed in a controlled way	▪ Installing automatic feeders for fibers and fruit stones
	Low combustion efficiency due to lack of control measures	▪ Installing control measuring devices (CO_2 levels, smoke, air pressure, steam pressure)
Optimizing combustion processes in boilers	Combustion inefficiency due to a lack of oxygen in boilers	▪ Preventing air leaks from boiler doors ▪ Increase fan capacity to allow greater flows of oxygen ▪ Installing nozzles to allow greater distribution of injected air ▪ Increase the height of chimneys to allow greater dispersion of particles material
	Removal of particles from chimneys	▪ Installing single-phase whirlwind machines (with 40 - 50% efficiency) ▪ Installing double-phase whirlwind machines (with 70 - 85% efficiency)
Byproduct management		
Use of byproducts to enrich the soil used for crop cultivation	Odors and water pollution from sludge water coming from treatment lakes	▪ Using bottom sludge as crop fertilizer ▪ Using floating sludge as crop fertilizer
	Sewage emitted into water	▪ Using treated water from water treatment lagoons as a fertilizer for palm crops
	Odors and husks	▪ Using bunches (approximately every three years) as a fertilizer for palm crops is beneficial because they can release organic matter, regulate humidity and create habitats for beneficial insects
	Particle dispersion and space taken up by ash	▪ Mixing boiler ash with sludge from water treatment lagoons which has high levels of potassium
	Particle dispersion and space taken up by fibers	▪ Using fibers as fertilizers which help to enrich the soil by adding organic matter
Use of byproducts as fuel	Particle dispersion and space taken up by cells	▪ Using fruit stones as fuel in boilers. The boiler grills need to be adapted to avoid silica scum forming ▪ Using fruit stones to clearly mark off the roads in a plantation
	Methane gas emissions which contribute to the greenhouse effect	▪ Using methane gas from oxidation lakes as a fuel for electric generators in the mill

Source: DEO, 2002.

Environmental Management Systems

Structuring environmental management systems is important if environmental issues are to permeate all aspects of a business. This can bring significant environmental benefits for businesses in general. An environmental management system is defined as, "planned and coordinated management decisions, operating procedures and collating and recording data, which are implemented by using a specific organizational structure with defined criteria and aims, assigning of responsibilities and resources. The overall goals of environmental management systems are to prevent negative impacts on the environment and promoting behavior and schemes that conserve and improve environmental quality" (Unep, 1995). Environmental management systems are structured in the same way as other environmental quality systems, such as the ISO 9000.

For companies which ISO 9000 certification, structuring environmental management systems is the next logical step. By December 2003, 6 oil palm companies gained ISO 9000 certification in quality management systems, while 22 companies are in the process of obtaining ISO 9000 certification. In 2003, Fedepalma and Cenipalma started a period of training to obtain their SGC certification (Mazorra, 2003).

Currently, 44 per cent of oil palm companies have not yet begun to structure their quality management systems. For these companies, the short-term challenge entails getting the formalization process off the ground. For companies that are certified or are in the process of obtaining ISO 9000 certification, the short and medium term challenges are to go through the processes needed to get ISO 14000 certification.

Structuring environmental management systems is important if environmental issues are to permeate all aspects of a business. This can bring significant environmental benefits for businesses in general

Implementing environmental management systems in companies involves (Unep, 1995):

- Identifying and controlling environmental issues, impacts and risks that affect a company.

- Complying with existing company environmental policy, including environmental aims and goals and state environmental legislation.
- Developing a mission statement that acts as a future guide, setting out a company's commitment and responsibility in terms of protecting the environment in the future.
- Establishing short, medium and long-term goals which focus on a company's environmental strategy. This involves reaching a balance between the financial costs and the resulting benefits, both for the company, shareholders and interested parties.
- Identifying what resources are needed in order to improve environmental performance, including which employees are responsible.
- Outlining in employee manuals the specific tasks, responsibilities and of each employee to ensure they carry out their daily responsibilities. This helps to limit and even eliminate adverse environmental impacts.
- Disseminating information contained in employer manuals so that every employee is aware of their responsibilities and company aims. This involves providing staff development so that each employee can effectively carry out their responsibilities in the company.
- Measuring performance against previously agreed goals and standards. Adapting and changing the focus of goals where necessary.

These recommendations will have direct and indirect benefits on the environmental performance of oil palm companies. The main direct benefit is the reduction in waste production and a decrease in pollution. In addition, there are other benefits which affect the running of a business in a positive way, for example: increased efficiency management systems, reduction in costs, a better quality product with increased consumer confidence, more interest from investors, improved credit rating status, improved relationships with environmental authority and an enhanced public image (Hoof, 2001).

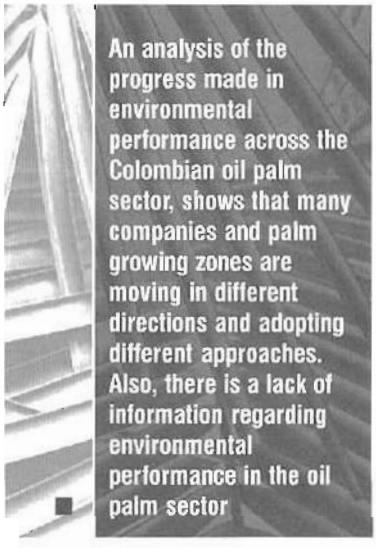
The majority of the costs that arise from implementing environmental management systems come from the time that is spent initiating new environmental measures and strategies, personnel training, administrative costs and money spent on obtaining certification.

Strengthening Environmental Management in the Oil Palm Sector

An analysis of the progress made in environmental performance across the Colombian oil palm sector, shows that many companies and palm growing zones are moving in different directions and adopting different approaches.

Also, there is a lack of information regarding environmental performance in the oil palm sector. This means that progress is open to debate and is not transparent. Also the lack of data makes is difficult for interested parties such as environmental authorities, NGOs, commercial clients and investors to assess environmental performance in general. However, the lack of information does not mean that there has not been progress in environmental management across the palm sector (WBCSD, 2002). But more emphasis needs to be placed on disseminating information about the palm sector's environmental performance and create environmental information systems with the help of government agencies.

Business transparency is important especially in global markets. For example, the Colombian flower and banana growing industries voluntary implemented environmental management programs known as Florverde and Banatura respectively (Isaza, 2003; Laverde, 2003) to increase their competitiveness in the global market. The main objectives of business transparency programs are, "to reinforce a culture of continual progress and reach the high standards set regarding the social and environmental goals of acompany. This includes consolidating creative information systems across the sector which allows its sector partners to be better supported and represented. The overall goal is to overcome challenges arising from environmental management and work towards achieving sustainable development" (Asocolflores, 2002).



One main focus of business transparency programs and other environmental self-

management programs is to implement systems that promote sustainability in each sub-sector and sector and introduce performance indicators that can measure progress. Performance indicators enhance environmental performance as a whole. This involves keep a record of good practice, assessing environmental performance based on national and international environmental laws and the standards set by interested parties. In addition, performance indicators allow companies to asses their progress by comparing their performance with other companies, known as *benchmarking*. Performance indicators also promote relevant research and the sharing of technological strategies across the sector (Isaza, 2003).

By 2020, the main challenge facing the palm sector is to develop environmental self-management programs which form an integral part of the sector's future plans. Implementing environmental self-management plans in each sub-sector of the oil palm industry promotes discussion about the sector's sustainability and expansion, both in manufacturing process and commercial expansion.

New Strategies by 2020

The palm sector needs to adopt specific strategies if the sector is to respond to the challenges posed by environmental management in the future. These strategies need to take into account current good practices and the main trends in environmental management. A good point of reference is the model proposed by the European Community Economic Commission that sets out the processes in the development of environmental management in five phases (Gradedel, Allenby, 1995) (Table 4).

Table 4 shows the different stages involved in implementing environmental management strategies and how they develop. Many oil palm companies have used the model to identify the exact stage they consider their company to be at. Some companies have not been able to determine the exact stage they are at because the features and characteristics found in their company fall into more than one stage.

According to Table 4, environmental management in the oil palm sector is working towards reaching the industrial ecological farming stage (Phase 5). The key idea behind industrial ecological farming is

Table 4 Changing the focus of environmental management

MANAGEMENT FOCUS	CHARACTERISTICS
PHASE 1	
Ignorance. Environmental problems are not known.	Companies create policies to tackle environmental problems but perceive complying with environmental norms as a burden in terms of company development.
PHASE 2	
Lack of interest. Environmental problems are known but they are not considered important.	Companies seek to comply with environmental regulation by focusing on the source of pollution. For example, end-of-pipe solutions are introduced.
PHASE 3	
Reliance on technology. The idea that all environmental problems can be solved by technology.	Companies adopt long-term plans and risk management as an important way with which to balance and cater for potential environmental commitments and ensuing costs in the future.
PHASE 4	
Towards sustainability. Introducing different measures which promote environmental sustainability across the company.	Companies who recognize that preventing pollution is more cost-effective than controlling pollution. Companies seek to limit sewage by reducing sewage production at its source.
PHASE 5	
Agroindustrial ecology. Integrating ecological cycles in all activities and processes.	Companies who adopt environmental management quality systems as part of quality controls in general. This allows environmental quality levels to be managed integrally.

to be able to assess and limit the palm industry's environmental impact during all its manufacturing and farming processes.

Applying the model (Table 4) in the palm industry means that in all design and planning processes, including the manufacturing stages and expansion of oil palm plantations, environmental sustainability and competitiveness are taken into account (Graedel and Allenby, 1995).

This type of strategic management focus, as outlined in Table 4, is sustainable in the long term. This model emphasizes a systematic approach that involves manufacturing processes to be developed in an integral way in relation to the environment rather than in isolation. Furthermore, this approach encourages the planning and implementation of environmental management systems to be influenced by the environment itself. But it requires continual planning and updating, particularly taking into account new technological developments. Thorough and coherent government policies are also needed to support its implementation.

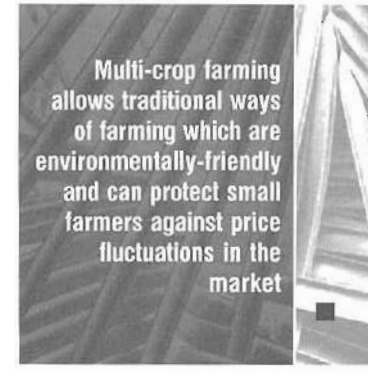
The main focus of industrial ecological farming is to encourage ongoing dialogue between the interested parties (*stakeholders*) and the company. In practice, this means broadening the traditional view that dialogue only occurs between three interested parties (investors, employees and clients) and promoting the idea that dialogue occurs between a broad range of interested parties and palm companies (WBCSD, 2002).

Employees are those groups who are directly interested in a company, followed by those who influence indirectly on a company known as participating parties, including clients, suppliers, capital markets, financial analysts, NGOs and government and community-based agencies. Participating parties have interests which are different from the oil palm sector's interests and which may, in some cases, lead to conflict. Strategies dealing with environmental sustainability should be based on an analysis of the particular and often similar interests that the industry and all interested parties share and examine how each party perceives the issue of environmental sustainability and its impact on the oil palm sector's competitiveness. This means that oil palm companies need to develop a custom-made sustainability strategy designed according to the interests of all parties.

There are aspects of industrial farming ecology strategies which encourage and support the development of environmental management in the oil palm industry in Colombia. In order to enhance biodiversity management, the introduction of the Ecological Infrastructure (EI) model is recommended. Ecological Infrastructure is defined as, "groups of relicts of natural and semi-natural vegetation, corridors, and restoration areas present in agroecosystems and other areas in the country (urban centers and other constructed systems) which con-

tribute to biodiversity conservation, productivity and quality of life". The EI model can be used as a tool to promote improvements in environmental management, especially in biodiversity protection, use of water sources and other environmental issues that arise from agro-ecosystems. Ecological Infrastructure is discussed in more detail in Annex 3.

In order to achieve sustainable management during the filtering stage, adopting the "zero emissions" approach is recommended. Zero emissions are defined as, "changing the existing idea that just waste is generated during all productive processes, to the notion that everything which is produced is useful. This involves integrating water products with similar and or different productive process" (Suárez, Ávila, 2002). This idea also emphasizes limiting waste production and optimizing levels of efficiency during production processes.


Multi-crop farming allows traditional ways of farming which are environmentally-friendly and can protect small farmers against price fluctuations in the market

In addition, Life Cycle (LC) can be used as a tool with which to integrate the cycles of the materials produced and used. This means getting greater added value from all the natural resources, energy, and capital used. Life Cycle Assessments are defined as, "a systematic approach that takes into account all possible sources that may affect the environment during all the components and stages in the production of a product, such as the extraction of raw materials, product production, distribution, packaging, and product use until its disposed. This allows more sustainable alternatives to be used which also enhance the value of products" (Hoof, 2001) (Annex 4).

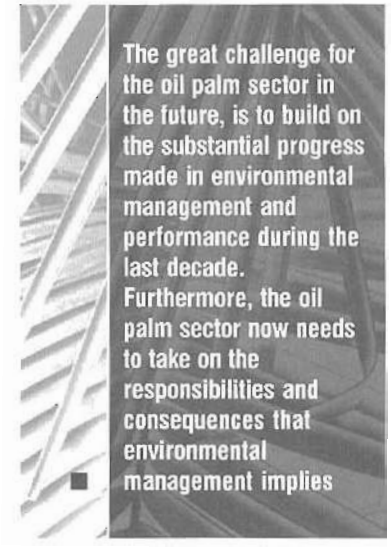
Finally, zero emissions and Life Cycle Assessment strategies promote the introduction of frameworks which can act as guides. This allows the oil palm sector to analyze its progress is it works towards environmental sustainability. Finally, it is important to note that if the oil palm sector is to become environmentally sustainable and friendly, it is essential that the palm industry has the will and is persistence to do so.

Conclusion

The great challenge for the oil palm sector in the future, is to build on the substantial progress made in environmental management and performance during the last decade. Furthermore, the oil palm sector now needs to take on the responsibilities and consequences that environmental management implies. Oil palm companies who have more advanced environmental management systems show that the sector as a whole is capable of changing into an environmentally-friendly industry and make environmental management an integral and key part of every oil palm business. Good environmental management has economic benefits and promotes the competitiveness of the oil palm industry in general. But some areas of environmental management in the oil palm sector still have a way to go. For example, soil management and water irrigation systems have only been developed recently. Particular focus needs to be placed on soil and water management if they are to play an important role in environmental management in oil palm plantations as a whole.

In addition, progress in environmental management also involves focusing more on cleaner production in mills by using a more structured approach. The oil palm sector has already committed itself to adopting cleaner production processes and integrating cleaner production into environmental management systems, as seen in some agreements signed with the Colombian government a few years ago. In general progress has already been made in cleaner production. For example, sewage treatment systems and environmental guides and management plans have been introduced. In addition, it is important that "zero emissions" and Life Cycle Assessment strategies which aim to use and increase the value of byproducts, are incorporated into long-term plans and strategies. It is also important to aim for "zero emissions" and use the life cycle approach as they all have a positive impact on the environment and benefit the sector's productivity.

As discussed earlier, good environmental management in plantations is assessed mainly in terms of its impact on biodiversity. The oil palm sector needs to ensure that the expansion of palm plantations does not change and tamper with forest ecosystems. The sector also needs to develop and strengthen good environmental management practices which promote agroecosystems and in particular introduce the



idea of Ecological Infrastructure as a way to protect biodiversities. Finally, the sector needs to ensure that environmental protection strategies vital for the sector's development, such as natural pest barriers and the protection of hydrographic basins, are in place.

In order to meet these challenges, oil palm companies must further strengthen and structure their environmental management systems in general. This also involves developing consistent and common strategies that allow oil palm companies to develop and move in the same direction. To this end, scientific and technological research carried out by Cenipalma and good management practices as promoted by Fedepalma's Environmental Unit, can all play a part in improving environmental management across the oil palm sector.

Conclusion

CHAPTER 4

Palms and pink cranes – Entrepalmas S.A.

arious questions have underpinned this study on environmental management and performance in the Colombian oil palm sector and industry views about environmental management. Namely, i) to what extent is the Colombian oil palm industry environmentally-friendly and compatible with the environment; ii) is the expansion of the oil palm industry environmentally sustainable? iii) do environmental issues pose a threat or an opportunity for the oil palm sector? iv) how do environmental issues affect the competitiveness of the oil palm sector in Colombia? v) which new strategies and measures need to be adopted by the palm sector in response to environmental challenges during the next two decades? These questions are discussed throughout this chapter.

The various conclusions reached in this study take into account the substantial progress made by the oil palm industry in environmental management and performance during the last decade. But it is essential that the oil palm industry continues to make great strides in improving its environmental management if it is to remain one of the key players in Colombia's development during the next few years.

Environmental Issues and the Competitiveness of the Oil Palm Sector

Environmental management needs to be at the heart of the Colombian palm sector's business strategy. This is important if the sector is to respond effectively to the main trends developing in the field of environmental protection both nationally and globally.

The following main trends in environmental conservation include:

- The growing importance placed on by citizens and their awareness of environmental issues both nationally and internationally.
- Greater priority given to environmental issues in business plans.
- The strengthening of national and international organizations who campaign to protect the environment.
- The growing awareness in global markets about environmental issues.
- A greater number of management systems which promote environmentally-friendly practices in businesses.
- A greater variety of different technological resources which tackle the new challenges arising from environmental issues.

Companies and manufacturing sectors, who boost highly developed and advanced environmental management practices, are aware that being competitive is intrinsically linked to the ability of a company and or sector to become real, "trustees of the environment". Moreover, consumers demand that businesses are environmentally-friendly in the long run. This has prompted many international companies to make the issue of the environment a central feature in their mission statements, visions and corporate strategies. In fact, during the last two decades it has become evident that it is possible to intertwine the issue of protecting the environment with maintaining and or improving a company's competitiveness in the market. However, the extent to which this is possible, varies among the different manufacturing sectors.

This study has emphasized that the oil palm agroindustry, due to its inherent features and characteristics, is able to develop business strategies that promote, "good business", in general and which more importantly are compatible with protecting the environment. But it has also been shown that environmental issues in practice pose both threats and opportunities for the oil palm sector. This is because this type of monoculture farming, oil palm farming, is located in one of the world's most diverse countries. This places great pressure on the use of renewable natural resources.

When including environmental issues as a key part of the oil palm agroindustry, the following three main points should be considered.

Firstly, developing and enhancing the legitimacy of the oil palm sector is based on harmonious and transparent relationships between the palm sector, environmental authorities and the community. Secondly, it is important to take into account how clients perceive the financial benefits of developing environmentally-friendly businesses. Thirdly, the Colombian oil palm sector needs to assess how effective environmental management and performance strategies are in practice.

Below is a list of objectives that can be used as a guide to help the oil palm sector implement a policy of environmental management and enhance its competitiveness:

- The conservation and enrichment of relicts of natural ecosystems in areas where oil palm farming is set to expand.
- The protection and enrichment of biodiversities in plantations.
- The conservation of water resources due to sewage emissions and the conservation of water basins.
- Promoting good soil management and enrichment in order to improve the soil's chemical, biological and physical properties.
- Promoting eco-efficiency during manufacturing processes and using byproducts efficiently.
- Marketing strategies which promote and emphasize that palm oil products and the oil palm industry are environmentally-friendly.

Developments in Environmental Management

Environmental management needs to be at the heart of the Colombian palm sector's business strategy. This is important if the sector is to respond effectively to the main trends developing in the field of environmental protection both nationally and globally

The most important environmental issue facing the oil palm industry is its potential impact on biodiversities. Although the impact of particular palm plantations on the environment has still not been clearly determined, it cannot be denied that in the past the introduction of some oil palm plantations impacted on natural ecosystems. But is it important to note that the impact on biodiversities as a result of oil palm farming in Colombia is much less than what has

been documented in other palm oil producing countries. In Colombia, around 85 per cent of the lands currently used for palm cultivation in the past were used for short crop cycle cultivation and large-scale cattle raising, types of agricultural farming that impact more on the environment than oil palm farming. Moreover, the introduction of oil palm farming means that there are greater opportunities to develop more diverse biological communities than those found in cattle raising and short crop cycle cultivations.

It is also important to highlight other trends in environmental management practiced in oil palm plantations that protect biodiversities. These measures arose in response to problems existing in oil palm farming management and the market in general. The following trends in environmental management are emphasized:

i) Since 1991, applied research conducted by Cenipalma on optimizing oil palm yields and practices used in mills has played a key role in achieving positive results in the field of agronomic management. As a result during the last decade, new forms of agronomic management primarily targeting pest control and prevention have been developed by the oil palm sector. This has impacted positively in terms of protecting and enriching the flora and fauna and protecting the diversity of microorganisms in the soil. New agronomic management systems include integral pest management systems which involve improving oil extraction processes and the use of biological controls and organic palm farming.

ii) Since the early 1990's, some companies in the North Zone have been involved in organic oil palm farming and have obtained organic certification.

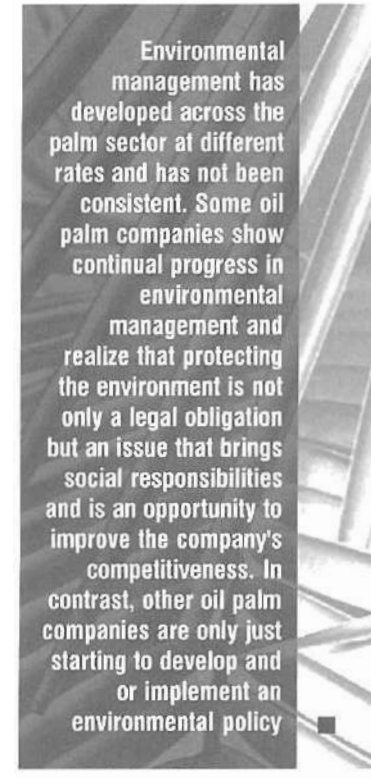
Since the early 1990's, environmental management in mills was relatively underdeveloped. Since then important progress has been made and documented. This can be seen in the rapid growth of sewage treatment plants in mills and the adoption of environmental management plans which have been approved by environmental authorities.

But environmental management has developed across the palm sector at different rates and has not been consistent. Some oil palm companies show continual progress in environmental management and realize that protecting the environment is not only a legal obligation but an issue that brings social responsibilities and is an opportunity

to improve the company's competitiveness. In contrast, other oil palm companies are only just starting to develop and or implement an environmental management policy that merely complies with environmental laws. In other words, some companies view environmental issues as problems that must be faced, while others view environmental issues as opportunities that can be taken advantage of.

Challenges in Environmental Management

The great challenge facing the Colombian oil palm sector is to incorporate environmental issues into the heart of its business plans and strategies. This means that Colombian palm companies need to adopt more proactive approaches which go beyond than just complying with environmental laws. Such a proactive approach implies further developments in various areas, implemented both by individual oil palm companies and in collaboration with Fedepalma and Cenipalma.



Developments in environmental management in the Colombian oil palm agroindustry in the short, medium, and long terms are largely influenced by with what is happening globally, particularly in relation to Colombia's international competitors. This includes developments, trends, opportunities and threats posed by international competitors and the Colombian oil palm industry's strategic vision for 2020. By 2020, it is expected that production rates will grow sevenfold in comparison to existing palm oil production rates. In 20 years, it is expected that palm oil production will increase from 500,000 tons to almost 3.5 million tons. This represents an average increase in productivity by 40 per cent, from 3.9 to 5.5 tons of oil per hectare during the same period (Mesa, 2000). To reach these goals, the oil palm sector needs to export 80 per cent of its produce. Incorporating sound environmental management practices would greatly help the Colombian oil palm sector in reaching its production and export targets.

The challenges facing individual palm companies can be divided into two main categories, those that target plantations and those that deal with mills. Proactive environmental management used in plantations involves integrating environmental issues with the different types of agricultural activities. It also involves adopting practices which focus on key issues including promoting biodiversity protection and the sustainable use of biodiversities, water supplies and soils. Sustainable use of biodiversity is based on the idea that production levels in palm mills may be increased by strengthening the surrounding farming ecosystems and conserving and enriching the relicts of natural ecosystems located nearby. Environmental management in plantations also involves the following issues:

- Promoting the growth of secondary forests in plantations.
- Using Integral Pest Management systems as the main way with which to tackle the various pests that threaten oil palm crops now and in the future.
- Encourage the use of biological controls as part of the Integral Pest Management system.
- Good management of residual biomass.
- Optimizing the use of byproducts made from industrial processes.
- Greater emphasis on improving soil management, particularly focusing on long-term plans which deal with the protection of water microbasins.
- Zero emissions of sewage into water sources.

The challenge in the future for oil palm mills in terms of environmental management is to reach "zero emissions". This involves improving a mill's efficiency in general including, water pollution prevention and mitigation, reducing air emissions and good management of byproducts. In order to achieve "zero emissions", in mills, a number of measures, both in the short and medium term, have been identified. These include: limiting the amount of waste produced at the source by adopting better control measures and good manufacturing practices, optimizing the use of byproducts and using them efficiently, recycling water and sewage and finally improving ways of treating water. To implement these measures, oil palm companies must structure and certify their environmental management systems.

In order to implement all of the above measures, the oil palm industry as a whole must promote itself as an environmentally-friendly agroindustry. As palm growing areas expand, more detailed and extensive environmental studies need to be carried out on lands singled out for further oil palm expansion. Future research needs to focus on potential environmental impacts and restoring, protecting and expanding natural forest relicts. This is particularly important when considering that biodiversity conservation has gained importance both globally and in Colombia. As a result, the oil palm sector and the Colombian government both need to establish a very clearly defined environmental policy that focuses on protecting natural ecosystems in those areas marked for future oil palm expansion. For example, the controversy caused when palm plantations were introduced in the Tumaco area and their eventual adverse impact on biodiversities is an important case study for the palm sector.

The challenges facing individual palm companies can be divided into two main categories, those that target plantations and those that deal with mills. Proactive environmental management used in plantations involves integrating environmental issues with the different types of agricultural activities. It also involves adopting practices which focus on key issues including, promoting biodiversity protection and the sustainable use of biodiversities, water supplies and soils

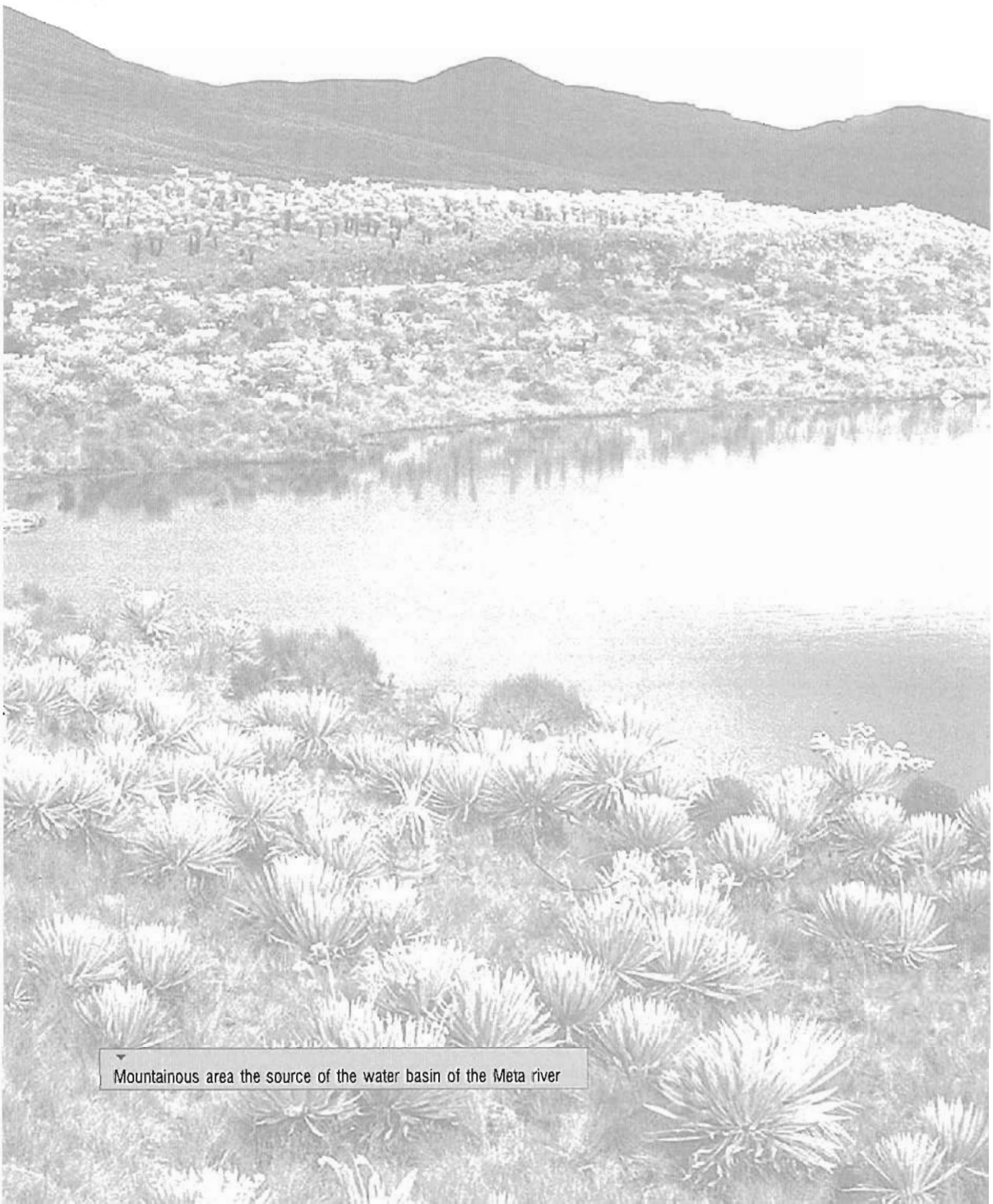
If the oil palm industry is to be perceived as an environmentally-friendly sector, then it is important to create transparent information systems about the sector's environmental performance. This includes creating a system of environmental performance indicators, for both mills and plantations. Environmental performance indicators form key components in environmental management systems in oil palm companies, providing important information to the public. This type of data would help compare environmental performance among different oil palm companies more effectively by using benchmarking.

It is essential that Cenipalma and mills in general promote technological research and development to meet the environmental challenges facing the oil palm sector. Future research needs to focus particularly on the use of oleochemistry in the oil palm sector in general and the efficient use of oil extraction byproducts. As palm growing areas expand, better and more thorough environmental studies need to be carried out on lands singled out for further oil palm expansion which

focus on potential environmental impacts and restoring, protecting and expanding natural forest relicts. Despite notable progress being made, the vast climatic and ecological differences which exist between the four main palm growing zones, as well as local differences within each zone, means that research plays a key role in environmental management and influences the types of farming practices used.

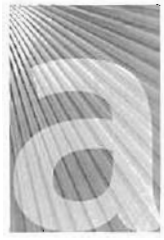
In addition, ecological infrastructure and Life Cycle Assessments and the challenge posed by "zero emissions", can all promote the development of environmental management systems in the oil palm sector. These measures can also help to integrate all of the sector's activities with the surrounding environment. Finally, the extent to which the oil palm industry develops into an environmentally-friendly industry depends on whether the oil palm sector as a whole has the tenacity and will to do so.

Annexes



Mountainous area the source of the water basin of the Meta river

Annex 1
The Oil Palm Sector in Colombia



nnex 1 discusses the origins of palm farming in Colombia and the various stages involved in harvesting and producing palm oil. In addition, palm oil and its many different uses will be examined.

The Oil Palm Sector in Colombia

The African Palm, *Elaeis guineensis* Jacq, is originally from the Gulf of Guinea, West Africa, extending 15° along the north-south latitude.

Palm farming has spread to different parts of the world, including Latin America and Southeast Asia, where the largest oil palm plantations are found. In 2001, Malaysia was the largest palm oil producer, accounting for 45 per cent of the world's production, followed by Indonesia (31%), Nigeria (5%), Thailand (3%) and the Ivory Coast (2.05%). Colombia is the world's fifth largest producer, accounting for 1.95% of the world's palm oil production (Fedepalma 2003 Statistical Yearbook).

Oil palm was first introduced in Colombia in 1932 by Florentino Claes. He planted a few species of oil palm as decorations in a farm in Palmira (Valle del Cauca). In 1945, oil palm first started to be produced commercially by the United Fruit Company in the department of Magdalena.

Oil palm farming in Colombia has expanded at a steady rate. By 1960, 18,000 hectares of oil palm were under cultivation. By 2004, there were 185,165 hectares of planted oil palm, including 145,027 under cultivation and the remaining 40,138 hectares currently being developed for future oil palm farming.

Below are the main oil palm growing zones in Colombia:

- East Zone - includes the departments of Caquetá, Casanare, Cundinamarca and Meta. The East Zone is Colombia's largest palm farming area, accounting for 30.8 per cent of the total area used for palm farming.
- North Zone - includes the departments of Antioquia, Cesar, Magdalena and La Guajira. Accounts for 29.3 per cent of the total area planted.
- Central Area - includes the departments of Bolívar, South of Cesar, Norte de Santander and Santander. Accounts for 26.4 per cent of the total area planted.
- Western Area - includes the department of Nariño, nearly 13.5 per cent of the total area planted.

The Colombian oil palm industry is one of the most competitive in the world. Palm oil is one of Colombia's most important exports. In 2002, 528,400 tons of crude palm oil and 48,717 tons of crude palm kernels were exported.

Oil Palm Production Chains

There are various stages involved in producing palm oil, including cultivation, oil extraction, the different uses of palm and palm kernel oils and possible uses of byproducts obtained from oil palm.

Cultivation

Oil palm is a perennial fruit with a productive life span of over 25 years. Oil palm trees start to bear fruit two to three years after planting. Of all the oleaginous seeds, oil palm produces the greatest amount of oil per hectare. Oil palm fruits contain 50 per cent oil and can yield between 3,000 to 5,000 kg of palm oil per hectare and 600 to 1,000 kg of palm kernel oil.

Oil palm farming favors flat, semi-flat, or slightly undulating lands. Optimum farming conditions for oil palm cultivation are in regions with temperatures of 23 - 27 °C, rainfall 2,000 - 4,000 mm and altitudes not exceeding 500 m above sea level.

The different stages[1] involved in oil palm cultivation include, adapting lands for palm farming, introducing protective plant coverage, setting up pre-nurseries and nurseries, planting, crop maintenance (plateo and pruning), harvesting (cutting of bunches) and plantation upkeep.

Adapting land for palm farming

Adapting land for palm farming varies according to the distinct geomorphologic and topographical features of the land where palm farming is planned. The first stages involved in land adaptation are: cleaning lots, leveling terrain, adapting irrigation and drainage canals and building access roads.

Introducing protective plant coverage

Before oil palm cultivation starts, various plant species, including *Pueraria phaseoloides, Arachis pintoroi* and *Desmodium ovalifolium* are introduced in plantations. Plant cover helps the soil to incorporate nutrients and organic material and also helps to maintain soil moisture and avoid erosion.

Setting up pre-nurseries and nurseries

The first stage is known as the pre-nursery stage and lasts around two to three months. Germinated oil palm seeds placed in bags containing disinfected soil with good moisture are taken to greenhouses covered by polyshade. The second stage, known as the nursery stage, lasts six to seven months. A specially designated area in a plantation is used to carry out fertilization, irrigation, and pest control. Next, vegetable matter with prime agronomic conditions is selected.

Planting

Usually, just before the rainy season starts, seeds grown from the nursery stage are selected and moved to designated areas in a plantation. In general, 143 palms are planted per hectare.

[1] Established in the *Guía ambiental para el subsector de la Agroindustria de la Palma de Aceite - Environmental Guide for the Oil Palm Agroindustry*, Fedepalma, Ministry of the Environment, SAC 2002.

Pruning

This involves cutting leaves off a palm tree to ensure its proper growth. Pruning is carried out when first planting palm seeds and is repeated regularly as seeds grow. This practice helps to control weeds, fertilization and fruit picking.

Pruning at the base of the tree

Later three years after planting, palm trees continue to be regularly pruned up to three times a year. This involves cutting the leaves at the base of the tree which are no longer considered useful. Pruning helps to maintain the right amount of leaves needed for photosynthesis, a minimum of 36 leaves per plant.

Cutting bunches or harvesting

Harvesting is done throughout the productive life span of a palm tree which lasts around 25 years. This involves picking fruit at exactly the right time in order to ensure the extraction of good quality palm oil. The ripeness of palm fruit is determined by its color. Fruits which are not ripe have a pale green (*virencens*) and violet (*nigrescens*) color, turning to an orangey red color when ripe.

Plantation upkeep and replanting

This involves clearing old plants which can then be used as organic materials in soils after the decomposition process. Plantation upkeep occurs at regular stages and helps to control irrigation systems, fertilization and plant health. It also helps to obtain the prime conditions needed for optimum production levels.

Processing fruits in mills

Processing oil palm fruits involves various stages[2], including the transportation and delivery of fruits, sterilization, pitting, digestion and pressing, clarification, purification and drying fruits.

[2] Establecidas en la *Guía Ambiental para el Subsector de la Agroindustrial de la Palma de Aceite*. Fedepalma, Ministerio del Medio Ambiente-SAC, 2002.

Transportation and delivery of fruits

Freshly harvested fruits are immediately transported to the processing plants and or mills by trucks or tractors. The bunches are unloaded onto a receiving platform, fed through a chute system and then loaded onto wagons and cars which transport the fruits and bunches to the sterilization area.

Sterilization

This involves vapor-based sterilization in autoclaves (pressure 3 kg/cm^2, temperature around 130°C) for an hour and a half. The sterilization process deactivates lipase enzymes, enhancing oil quality as free fatty acids (FFA) are formed. In addition, sterilization helps fruits to soften more quickly which in turn helps to separate and detach the kernel from the fruit and oil extraction.

Pitting

This is when the rachis and the fruit are separated using a pitting drum. The fruits are then transported to digester machines. After bunches with no fruits have decomposed they are used as organic material on palm crops.

Digestion and pressing

This is the oil extraction stage. Digestion and pressing processes involve macerating fruits with hot vapors under high pressure, usually using a double screw press. This heat-based process forces cells which contain oil, located in the fruit's mesocarp, to break. As a result, a certain amount of oil is extracted which is then collected in crude palm oil tanks and is later processed in the settling and clarifier tank.

The solid part produced as a result of macerating is put into to a fiber-removing machine so that the nuts can be separated and processed to obtain palm kernel oil. The fiber produced as a result of this process can be used as fuel in boilers generating water vapor.

Clarification and purification processes

The substances produced from the digestion stage are transported to a clarifier tank so that oil can be separated from the solids and purified.
Static systems in vertical circular tanks, horizontal quadrangular tanks and or dynamic systems (centrifugal) can be used during the clarification process. The products produced after the clarification stages are taken to sedimentation tanks allowing heavy particles to precipitate.

Drying

Heating systems and atmospheric or vacuum drying systems are used to reduce moisture in the purified product.

Uses of palm oil

Palm oil is used in a variety of ways, both in the food industry and other industries.

In the food industry

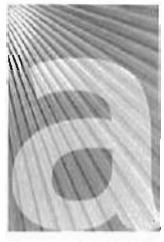
Palm oil contains equal proportions of non-saturated fatty acids, comprising 40% oleic acids (monounsaturated), 10% linoleic acids (polyunsaturated), 44% palmatic acids (saturated) and 5% stearic acid (saturated). Palm oil is a natural source of vitamin E and tocopherols and tocotrienols. Unrefined palm oil is also an important source of vitamin A. Both pulp and almond oil are used to produce margarine, lard, and cooking and table oil, which accounts for 52 per cent of palm oil produced in Colombia.

Uses of palm oil in other industries

- Palm oil is a raw material widely used in soaps, lubricating grease, metallic dryers, paint, varnishes and dyes.
- In comparison to the common chemical oils derived from petroleum, palm oil contains biodegradable components which makes it particularly suitable for the production of chemical oils.

- In the future, a great potential use of palm oil is as a fuel, known as biodiesel. This is particularly beneficial as biodiesel produces less smoke, contains fewer particles in the exhaust and emits less sulfur oxide and carbon monoxide into the atmosphere in comparison to petroleum-based fuel.

Annex 2
Ecological Infrastructure



nnex 2 focuses on ecological infrastructure and its impact and use in the palm sector. Past experience has shown that the oil palm industry within the next 20 years is ready and able to adopt ecosystem management systems across the sector by using Ecological Infrastructure. This can help the oil palm industry to become more competitive and contribute to society in general.

Introducing Ecological Infrastructure in the Oil Palm Sector

The oil palm industry can greatly benefit from building an Ecological Infrastructure (EI). EI can be used as a tool with which to make improvements that benefit the environment, including biodiversity and water sources (Van der Hammen, Andrade, 2002). According to these authors, EI is defined as, "natural and semi-natural vegetation, corridors and areas present in agroecosystems which are planned to be restored, including areas which have been affected by human activity (urban centers and other built up-areas). EI can promote biodiversity conservation, productivity and quality of life in general".

According to Lee (2002), Ecological Infrastructure is, "remaining land that is used as habitats for flora and fauna. EI is made up of linear elements such as electrical fencing, biological corridors and non-linear elements such as islands of vegetation found across the countryside".

EI planning uses semi-detailed scales (1:500,000). For EI to work successfully in the oil palm industry, it needs to be introduced at the regional level and not just during production processes. EI can cover about 7-10 per cent of surface areas previously affected by human activity. This helps to promote a healthy environment and protects crops against pests and extreme weather (Van der Hammen, Andrade 2002). In any area under cultivation, 15 per cent can be EI with non-linear elements and 5 per cent with linear elements, such as using vegetation to mark off boundaries. According to Lee (2002), an *Ecological Infrastructure Index* (EII) can be used to measure progress.

EII = ecological infrastructure reached/ecologic infrastructure desired x 100

In such a way, EI can be used in new oil palm plantations and help to promote more diversified agroecosystems.

Disposing large amounts of solid by-product biomass is a common problem in agroecosystem management. However, as the following example from Costa Rica shows, the surrounding environment and ecosystems can actually be used in a positive way. In the past, the citric industry in Costa Rica, Guanacaste, faced problems regarding the disposal of waste products in a protected area of dry tropical forest targeted for restoration. In this case, the idea was to charge interested parties for ecological services against rotting, the same amount that would normally be spent on disposing waste products by regular means (Daily, Ellison 2002). This innovative measure can also be applied to agrosystems in the oil palm sector whereby selected abandoned or degraded lands, taking into account their local features, can be used for ecological services against rotting. Profits from ecological services can later be used to buy and or restore degraded lands. In the future, these lands may even become protected areas.

Why Introduce Ecological Infrastructure?

The reasons why EI is beneficial has already been discussed throughout the book. However, it is useful to summarize current views about EI.

It has been claimed that oil palm agroecosystems damage the environment because of their simplified ecological structure and monoculture-based farming practices (see Boucher *et al.* 1991; Vandermer

1991). Furthermore, according to some experts, monoculture-based farming practices may in the long term affect the richness of the soil (Van der Hammen in conversation with Germán Andrade).

Pest attacks in monoculture farming continue to raise concerns. This concern is shared by Genty (1998, quoted by Calvache 2002) who states that, "in large plantations, spreading over more than 5,000 hectares, pests always gravitate towards the heart of a plantation. Fewer pests are found in the peripheral lots of a plantation, close to woods and native vegetation".

It is well known that good practice in plantations involves preserving areas of natural vegetation relicts, such as woods or a stubble area. It is also important to allow the growth of wild plants and leave areas between rows of palm trees for spontaneous vegetation to grow. The issue of pest management should be seen as part of protecting ecosystems in general. This not only helps in pest control and prevention management but also promotes biodiversity in agroecosystems. These ideas can be found in the book entitled "*An Environmental Guide for the Oil Palm Agroindustry*" (Fedepalma, MMA and SAC, 2002, see p. 64 and 65 and poster 17). But for significant progress to be made in setting up sustainable agroecosystems, it is important to see ecological improvements on a large scale and strive towards greater structural diversity, including habitats and species. All the above measures can help reduce potential pest attacks in oil palm plantations.

In general, pests and pest attacks in tropical agroecosystems are unpredictable. For this reason, it is important to focus on pest prevention measures and find ways to strengthen the stability and complexity of agroecosystems. It is well known that that the most diverse and complex ecosystems are the most stable ones, particularly in terms of their ability and resilience to cope with changes in the environment. Ecosystem stability and resilience is discussed below.

Stability and Resilience
(Based on McCaprian 2000)

The relationship between biological biodiversity and ecosystem stability has continued to raise interest and debate among ecologists. Before 1970, the prevalent view was that there was a simple positive relationship between diversity and stability. This view was based on empiric evidence that showed that the least developed biological communities were more susceptible to invasions of exotic species. The simplest agroecosystems were also more likely to be affected by environmental or biotic phenomena.

However, the relationship between biodiversity and stability may be seen in some but not all types of biological communities. This is particularly important to bear in mind when looking at biotic communities, where interactions between different species are greater and more noticeable. In biotic communities, each species can react differently in the face of external threats and or changes. For this reason, ecosystem resilience as a whole increases while reactions from individual species are lessened.

In such a way, the eventual extinction of a species and the function that a species carries out is more likely to be compensated in diverse communities than in simple communities. This is known as the redundancy effect.

Defining diversity has also changed. Diversity is about the diversity of ecological functions that are carried out, in other words, the complexity of biotic interactions, rather than the number of species per se. Although the relationship between stability and resilience remains debatable, it is clear that the most diverse biotic communities are potentially better prepared to respond to outside threats and or changes than ecological communities which are less diverse.

As far as agroecoystems are concerned, the diversity-stability debate is important in terms of spatial scales and maintaining a balance between biotic relationships and pest control.

Annex 3
The Zero Emissions Challenge

nnex 3 discusses the zero emissions approach and its use in the oil palm agroindustry. Aiming for zero emissions involves the efficient use of products and byproducts during and after manufacturing processes which can benefit the environment and reduce costs. The zero emissions approach is based on the idea that all types of waste produced in any manufacturing processes have a use. In such a way, it is possible to integrate any product considered as waste into other manufacturing process. In general, the zero emission approach improves efficiency and therefore makes industry more competitive.

The Zero Emissions Challenge

The zero emissions challenge aims to promote the efficient and sustainable use of renewable natural resources and resources used during manufacturing processes. In the case of the oil palm sector, oil palm accounts for just nine per cent of the biomass produced in a plantation. As a result, the remaining 91 per cent which is made up of effluents, empty bunches, fruit stones and fiber, leaves and trunks can all be potentially used as byproducts (Pauli, 1997). It has been shown that using the above different types of waste products can be cost-effective and promote the efficient use of renewable natural resources.

The zero emissions approach allows residual waste to be turned into byproducts using new innovative ways. This approach is particularly useful in those industries which only use a small amount of their resources in production processes. But first it is useful to clearly define the following terms: byproducts and waste. Below is a list of useful definitions provided by the Environmental Protection Agency (EPA) (Virgon *et al.*, 1993):

Solid waste:	Measured in volume and or in terms of weight. Includes solid products or materials which are disposed in sanitary landfills, garbage dumps and incinerators.
Sewage:	Generally measured in kilograms per emission unit. Regulated means of emitting pollutants into bodies of water after sewage has been treated.
Byproducts:	A usable product which is produced while something else (the main product) is being made.

The zero emissions approach has two main features. Firstly, it aims to use resources and energy more efficiently by reducing the amount of sewage and waste produced. Examples of such good practice and technological improvements in the field of zero emissions are discussed in Jorgenson (1982), Teoh and Chia (1993) and DEO (2002). Further examples of good practice can also been seen Table 3 (Chapter 3 of this book).

Secondly, the zero emissions approach focuses on maximizing the aggregate value of a byproduct. In the oil palm industry, byproducts are commonly used as organic fertilizers and as biofuels. However, the aggregate value of these oil palm byproducts can be increased by using them in the following ways including, chipboard in furniture and construction (Chrew, 1987), paper and food products in the form of vitamin E, cellulose and glucose (Lim *et al.*, 1981).

In addition, there are other uses of oil palm byproducts. For example, byproducts can be harnessed in methanogenic lakes to produce methane gas which can be used as boiler fuel. Efficient use of byproducts can replace the use of fibers and cells and be used as crop fertilizer. Lastly, boiler ash can be used to enrich soils.

Furthermore, improving the use of liquid sludge from treatment lakes by using irrigation pumping systems can increase the nutrient value of sludge.

Potential uses of solid waste, sewage and byproducts in the oil palm agroindustry

Product	Amount	Where are used	Level of use	Potential use
Plantations				
Pruning	10,4 t/ha	Plantations	High	Extraction of Vitamin E, chipboard
Trunks	89,9 t/ha	Plantations In making furniture	High Low	Products made out of wood, paper pulp
Mills				
Bunches	20 - 23%	Plantations	High	Chipboard, MDF
Fiber	12 - 13%	Fuel	High	Chipboard
Stones	6 - 8%	Fuel	High	Activated carbon
Sludge	2 - 3%	Plantations	High	Concentrated animal foods
Boiler ash	0,4 - 0,6%	Landfills Plantations	High Low	Fertilizer
Condensed waste	12 - 20%	Integrated into bunches	High	Cellulose, proteins
		Recycling	Low	In the dilution of crude oil
Centrifugal waste	40 - 50%	Integrated into bunches	High	Palm oil recovery
Treated water	30 - 40%	Integrated into bunches	High	
Hydrocicloned produced water	5 - 11%	Integrated into bunches	High	Recycling

Source: Adapted from Teoh and Chia, 1993.

The above table shows how solid waste, sewage and oil palm byproducts are used in the oil palm agroindustry.

In any business, the zero emissions challenge requires adopting an integral approach and vision which ensures that all byproducts are used efficiently across the company. Progress in attaining zero emissions can be measured in the increased use and aggregate value of all waste and byproducts generated in a particular company.

Annex 4
Environmental Life Cycle Assessment

This annex discusses how using Life Cycle Assessment (LCA) methods can help improve environmental performance across the oil palm industry in Colombia. The Life Cycle Assessment method uses a systematic approach and is one of the main ways a product's environmental impact can be clearly measured. It examines all the possible ways a product can potentially impact on the environment from a cradle to grave perspective. All the stages involved in the manufacture of a product are considered including, raw material preparation, producing and transporting a product, its use and disposal. In the case of the oil palm sector, Life Cycle Assessment is important as it offers the sector alternatives ways with which to improve its environmental performance. It can also be used as a tool with which to identify ways of improving and developing products in the chemical and detergent sectors.

How Environmental Life Cycle Assessment Works

A product and the way it is manufactured can adversely impact on the environment during different stages of its life cycle. These stages include preparing raw materials, product distribution and use, marketing and end use of a product. Examining the impact of a product throughout the whole productive chain allows the environmental performance of a product to be analyzed (Poremski, 1993).

In the past, environmental impacts were examined in isolation. For example, air, water and soil quality were dealt with separately. Such an approach can often lead to poor decision making and performance results (OECD, 1995).

The competitiveness and sustainability of a company is related to the impact of a product throughout its life cycle and the interactions taking place between the different stages of production. As a result, it is

important that businesses adopt an integral approach in order to identify areas for environmental improvement. This approach forms the basis of Life Cycle Assessment methods, focusing on all environmental impacts from the cradle to the grave (UNEP, 1996).

Life Cycle Assessment consists of two main components. Firstly, the Life Cycle Inventory which involves the creation of an inventory of the inputs and outputs of most processes that occur during the life cycle of a product. Secondly, the Assessment Method, where processes identified in the inventory are examined using established environmental criteria (Kunht, 1993).

It is important that Life Cycle Assessment is carried out in a uniform way across all production stages to ensure optimum and reliable results. Life Cycle Assessment can be a general overall global survey using standardized data and also a comprehensive detailed study.

In general, there are four stages involved in Life Cycle Assessment (UNEP, 1996). The stages are as follows:

1. *Defining the aims and scope of analysis.* This involves deciding which product(s) are going to be analyzed. A basic unit of comparison is chosen and the nature and terms of the study are defined.

2. *Analyzing the inventory.* This involves measuring the amount of energy, raw materials, water and land used. In addition air emissions during production processes are monitored. The results are displayed in a process tree.

3. *Impact analysis.* The impact of using resources and air emissions are grouped together and measured according to specified criteria which are used to measure environmental impacts. Different types of environmental impacts are then ranked in order of their importance.

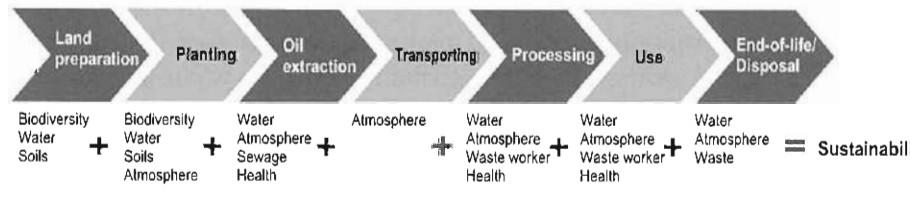
4. *Evaluation.* This involves reporting results in an informative and detail way. How to limit a product's environmental impact is systematically evaluated.

In the oil palm industry, environmental impacts can occur from the time when lands for palm crops are prepared to setting up plantations. During this stage, environmental impacts are linked to changes in land use. The next stage in the life cycle of an oil palm crop is what happens during cultivation. The main environmental impacts of this phase are to do with the use of agrochemicals and the effect these chemicals have on water, soils and the health of plantation workers using them.

Harvesting can adversely affect soil compression. Also, gas emissions from trucks and tractors contribute to air pollution. During the oil extraction process, environmental impacts are to do with water quality, air pollution, waste production and worker health. However, the use of byproducts including trunks, bunches, fibers, stones, sludge and methane gas can all contribute in a positive way to environmental performance overall (Teoh and Chia, 1993).

The oil palm sector's sustainability is also measured according to the resulting environmental impacts during oil extraction and the processing of final products, including their use and disposal. In general, environmental impacts focus on four main areas including water quality, air, waste and human health.

The following table shows the different stages in the life cycle of oil palm and the resulting environmental problems occurring at each stage. The product's environmental impact is the sum of all the different environmental impacts occurring during the entire life cycle.



How environmental Life Cycle Assessment works

Source: Odes, 2003.

The Importance of Using Life Cycle Assessment Methods

The importance of using Life Cycle Assessment methods in the oil palm sector can be seen particularly when dealing with chemical oils and detergents.

Since the early 1990's, Life Cycle Assessment has been used by major multinational companies such as Unilever, Henkel, and Golden Hope Plantation as a tool with which to make informed decisions about product buying, examine environmental performance and planning product strategies. Life Cycle Assessment has also been used effectively by scientific institutes in Europe and consumer organizations.

Life Cycle Assessment can enhance the oil palm sector's competitiveness in the international market by providing reliable data about the sector's environmental performance and sustainability. This is particularly important when considering that oil palm is one of the main alternative raw materials used in the production of chemical oils and detergents. This view is shared by an employee at Unilever (Postlethwaith, 1993). He said, "knowing and understanding where raw materials come from and how they are processes is essential. In particular, renewable materials like chemical oils have specific advantages. Many important renewable materials are chosen based on sustainability criteria. At Unilever, Life Cycle Assessment methods are used as an important tool in decision making, particularly when deciding which alternative raw materials should be used".

To summarize, Life Cycle Assessment is important in the oil palm industry in the following three main ways i) it makes the oil palm industry more environmentally sustainable which is particularly important in the global market; ii) it is used as a tool with which to introduce initiatives that deal with using subproducts efficiently which in turn increases a product's added value; iii) it offers alternative ways to improve production processes in general.

A recent assessment conducted across the Colombian oil palm industry showed that the sector has various distinct advantages in comparison with its international competitors. The competitive edge of the Colombian oil palm industry is further enhanced particularly if it

focuses on making progress in environmental management, in particular biodiversity and the use of byproducts.

It is important to emphasize that environmental sustainability in the palm sector is also influenced by how crude palm oil will be used in the future. The relationship between the oil palm crop and environmental sustainability directly affects the future success of the palm industry. Consumer awareness and perception about the oil palm industry as an environmentally-friendly and sustainable industry also plays an important part in the sector's future. For this reason, it is important that the oil palm sector focuses carefully on the environmental criteria used to define its products in future markets. Such future markets, for example using palm oil in chemical oil derivatives (biodiesel and biopolymers) may offer important opportunities for the sector in the future.

Using Life Cycle Assessment methods can also help in the efficient use of byproducts. For example, other uses of byproducts are recommended by a range of experts including Albarracín (1998), Del Hierro (1993), Kamaruddin, Basri and Jalani (1997). They emphasize using bunches and fibers in construction materials, the paper industry and lignin extraction. In such a way, limiting the environmental impact of a product and its byproducts can increase its aggregate value.

In addition, Life Cycle Assessment methods emphasize a systematic approach which promotes the use of preventive alternatives in extraction processes and can help to limit the sources of pollution and air emissions. Understanding the interaction and relationships between a raw material, its efficiency and how it is produced is the basis upon which environmental management and sustainability in companies is founded.

In conclusion, Life Cycle Assessment is a fundamental tool in the Colombian palm sector which allows the sector to strategically plan environmental management in general. Finally, the use of Life Cycle Assessment methods allows commercial strategies to be created and can enhance the environmental and commercial performance of the sector as a whole.

Glossary

Agrobiodiversity. Refers to the planet's different plants, animals and micro-organisms which are important directly or indirectly to human food security and agriculture, providing the basic needs and raw materials used by society.

Life cycle analysis. A methodology used to determine a product's impact on the environment by analyzing all stages of the product's life cycle - from the cradle to the grave. This includes examining how the raw material is obtained, produced, distributed and its use and end product.

Impact risk assessment. Is part of the life cycle analysis method. It involves determining the relationship between a product's environmental impact during and after its life cycle.

Benchmarking. A method which identifies the performance of different companies and or products by comparing them with other companies in the same field and or products with similar roles.

Natural forests. These are natural systems made up of complex communities home to living micro-organisms, plants and animals which interact and influence each other and are secondary to the dominant environment of tree species. Natural forests are characterized by the fact that they have not been changed as a result of human activity.

Dry tropical forests. Defined as areas of forests where there is continuous plant cover. Dry tropical forests are found between 0-1000 meters and in regions where temperatures are greater than 24 degrees centigrade, with an annual rainfall of 700 to 2000mm. In dry tropical forests there are usually one or two dry periods a year.

Biological controls. The use of predatory parasites, entomopathogenic agents and viruses to control parasitic populations, weeds and other pests.

Ecological agroindustry. The marriage of ecological agroindustries with natural ecosystems. Ecological agroindustry explores new ways to develop agroindustrial activity while promoting the development of environmentally-friendly production processes. In an agroindustrial ecosystem every process and or chain of processes is seen as an integral part of a whole system. This also means that the actions of producers and consumers are inter-related and determine what can be used and what can be thrown away.

End-of-pipe solutions. The treatment of contaminated substances at the end of the production stage after all products and waste have been disposed of (either through an outlet, chimney or other way). The term is usually used when referring to environmental control strategies.

Hotspot. Is defined as an area of great biodiversity. As a result, hotspots are very vulnerable to anthropogenic changes.

Ecological Infrastructure. Involves recovering and re-establishing all areas and corridors of natural and semi-natural vegetation and other areas such as urban centers in order to conserve biodiversity, productivity and quality of life.

Integral Pest Management (IPM). A type of pest control system which involves using biological, chemical and agricultural methods to tackle pests. IPM takes into account fluctuations in crop revenues and is carried out within a set time and framework.

Green consumerism. A generic term that refers to a group of potential and or active buyers of goods and services, who out of personal preference and or need, seek environmentally-friendly products. By its nature, green consumerism depends on the perception of the client i.e. "The market is green when a client recognizes it to be so".

Stakeholders. Refers to those people who are part of a group and or organization who have invested financially and or have an interest, a stake, in following company policy and development. Though stakeholders are not directly involved in the producer-consumer chain, they can indirectly influence the decisions taken by a company.

Cleaner production. An integral and preventative environmental strategy which promotes new more environmentally-friendly methods of production and aims to reduce damage to the environment and society. It also aims to reduce production costs of services and products.

Resilience. The ability of an ecosystem to recover to its former state after being exposed to low risk external hazards. The less resilient an ecosystem is, the more fragile it is.

Recovery. Refers to regaining partially or totally the structures and functions of ecosystems damaged by harmful human activity and natural causes.

Natural savannas. Are characterized as being ecologically homogenous and with unified tropical vegetation. In natural savannas, grasslands predominate and are intermingled with woody plants which grow side by side in the same environment.

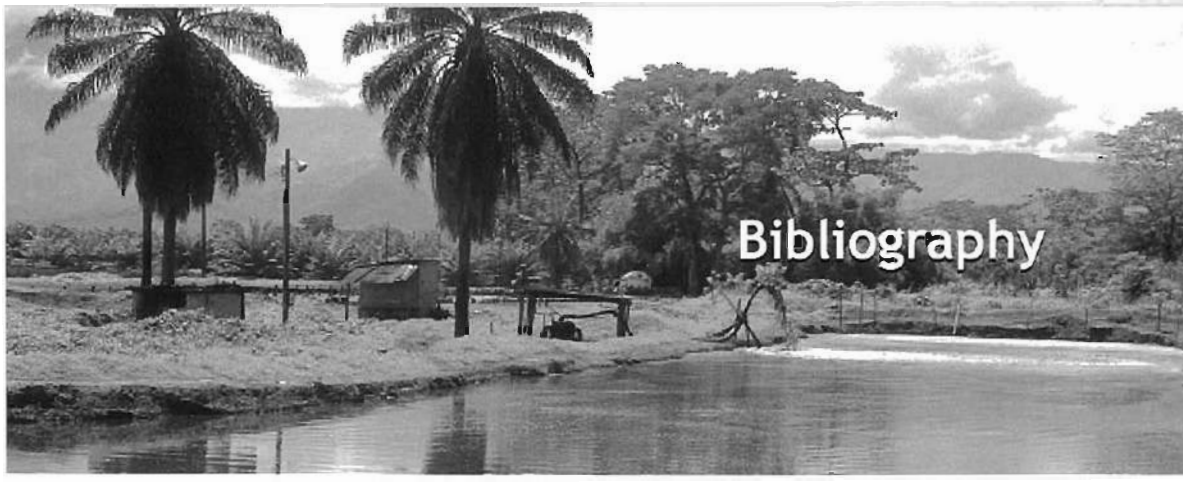
Relictual savannahs. Have the same features as found in traditional savannah areas. Relictual savannahs are scarce and localized.

Environmental management systems. Form part of the whole management system in a company, including how a company is organized and plans for the future, how it assigns responsibilities and its practices and procedures regarding the management of environmental related isues. Environmental management systems also involve the

development of processes and resources in order to develop, implement, achieve, assess and maintain environmental policies.

Sustainability. Any economic activity which considers the present needs of society without affecting the ability and capacity of future generations to fulfill their individual needs. Sustainability can be divided into three main components: economic, social and environmental. In economic terms, sustainability involves financial profits, staff salaries and contributions to the community. In social terms, sustainability involves policy that benefits society and labor legislation that guarantees workers' rights and welfare. In environmental terms, sustainability is about the environmental impact of economic activities on the atmosphere, water, land, natural resources and human heath.

Trustees. Refers to those people in charge of managing a project and or company.



Bibliography

Abraham, VK. 1992. Oil Palm and Environment. *Indian Oil Palm Journal* 2 (7): 7-10.

Albarracín, D. 1998. Concreto reforzado con fibras. *Boletín ICPC* (Medellín) No 82.

Aldana, C. 2000. Hormigas del género *Paratrechina* sp. *Ceniavances* (Colombia) 69:1 -4.

Aldana, C. 2002. Plantas nectaríferas en la regulación de insectos defoliadores y su manejo en plantaciones de palma de aceite. *In: Curso nacional manejo integrado de plagas en palma de aceite*. Centro de Investigación en Palma de Aceite - Cenipalma, Bogotá.

Aldana, RC; Pallares, CH. 2000. Control químico de *Stratetgus aloeus* (L.). *Ceniavances* (Colombia) 67:1 - 4.

Aldana, RC; Calvache, H. 2002. Plagas en palmas espontáneas. *Ceniavances* (Colombia) 92: 1 - 4.

Aldana, RC; Calvache, H. 2002. Manejo integrado de *Hispoleptis subfasciata* Pic, en palma de aceite. *Ceniavances* (Colombia) 91:1- 4.

Altieri, MA. 1995. *Agroecology the Science of Sustainable Agricultura*. Westview Press, Berkeley.

Andrade, G. 2003. Palma africana y biodiversidad en Colombia. Odes (inédito), Bogotá.

Argawal, A; *et al.* (eds). 2000a. PIC your poison: Convention on the Prior Informed Consent Procedure for Certain Harzardous Chemicals and Pesticides in International Trade. *In: Poles Apart: Global Environmental Negotiations, Vol. 2*. Centre for Science and Environment, New Delhi, 109-139.

Argawal, A; *et al.* (eds). 2000b. The Stockholm Convention on Persistent Organic Pollulants. *In: Poles Apart: Global Environmental Negotiations*, Vol. 2. Centre for Science and Environment, 109-139. "The Eliminator, 313-324, New Delhi.

Augura. 2001. Plegable informativo del programa Banatura.

Bárcenas, A; De Miguel, C. 2001. *El financiamiento para el desarrollo sostenible en América Latina y el Caribe*. Cepal-PNUD, Santiago de Chile.

Bejarano, JA. 1997. Un marco institucional para gestión del medio ambiente y para la sostenibilidad agrícola. *In:* Lucio G. Reca, y Rubén G. Echeverría (Comps.). *Agricultura, medio ambiente y pobreza rural en América Latina*. BID, Washington, DC.

Brady, N. 1974. *The Nature and Properties of Soils*. 8ª ed. Macmillan Publishing C. London.

Brañes, R. 2001. *El desarrollo del derecho ambiental latinoamericano y su aplicación*. PNUMA, México, DF.

Boucher, DH; *et al.* 1991. Agricultura. Capítulo 6. *In:* DH Janzen (Ed.) *Historia natural de Costa Rica*. Organización de Estudios Tropicales, San José.

Boucher, EH; *et al.* 2000. Country Capacity Development Needs and Priorities. *Regional Report for Latin America and the Caribbean*. GEF, UNDP, New York.

Bunch, R. 2002. Nutrient Quantity or Nutrient Access? A New Understanding of How to Maintain Soil Fertility in the Tropics. *In: Echo Development Notes*, January, Issue 74.

Centro Andino para la Economía del Medio Ambiente - Caema. 2001. Boletín No. 1. Bogotá.

Calvache, H. 2002. Manejo integrado de plagas en el agroecosistema de la palma de aceite. *In: Curso nacional de manejo integrado de plagas en palma de aceite*. Centro de Investigación en Palma de Aceite, Cenipalma, Bogotá.

Calvache, H; Franco, N; Aldana, JA. 1998. *Opsiphanes cassina* (Felder). *Ceniavances* (Colombia) 51:1-4.

Carrere, R. 2001. Oil Palm: The Expansion of Another Destructive Monoculture. *(on line)* World Rainforest Movement, http://www.wrm.org.uy/plantations/material/oilpalm2.html

Castaño, S. 1996. Informe final del estudio de impacto socioeconómico y ambiental de las industrias de palma africana y el camarón de cultivo, en el municipio de Tumaco, Departamento de Nariño. Informe a proyecto Biopacífico.

Fedepalma. 2001. *El cultivo de la palma de aceite y su beneficio. Guía para el nuevo palmicultor.* Fedepalma, Bogotá .

Chan, KW. 1981. Nitrogen requirements of oil palms in Malaysia: Fifty years of experiments conducted by Guthries. *In*: E. Pushparajah; Chew P.S. (Eds.). *The Oil Palm in Agriculture in the Eighties*. Volume II. Incorporated Society of Planters. Kuala Lumpur. 119-153.

Chan, KW. 1982a. Potassium requirement of oil palms in Malaysia: Fifty years of experimental results. *In*: E. Pushparajah; Sharifuddin H.A. Hamid (Eds.). *Phosphorus and Potassium in the Tropics*. The Malaysian Society of Soil Science, Kuala Lumpur. 323-348.

Chan, KW. 1982b. Phosphorus requirement of oil palms in Malaysia: Fifty years of experimental results. *In:* E. Pushparajah; Sharifuddin H.A. Hamid (Eds.). *Phosphorus and Potassium in the Tropics*. The Malaysian Society of Soil Science, Kuala Lumpur. 395-423.

Chew, PS; Kee, KK; Goh, KJ. 1999. Cultural Practices and their Impact. Chap. 4 *In: Sustainable field practices. Oil Palms and the Environment. Management Perspective.*

Conill, P. 2000. La valorización de los subproductos de la planta de tratamiento de los efluentes de la extractora de aceite de palma "Palmar Santa Helena" en Tumaco Colombia. *In: Palmas* (Colombia) 21 (Número Especial Tomo I): 250-255. Fedepalma, Bogotá.

Crew, LT. 1987. Particle Board Manufacture from Oil Palm Stem. A pilot study. *Frim Occasional paper No 4*. Forest Res. Inst. Malaysia, Kuala Lumpur.

Daily, G; Ellison, K. 2002. *The New Economy of Nature. The Quest to Make Conservation Profitable*. Island Press, Washington DC.

Del Hierro, E. 1993. Aprovechamiento de los subproductos de palma de aceite. *Palmas* (Colombia), 3(3): 54 - 55.

Department of Environment - DEO. 2002. *Industrial Processes & The Environment (handbook No. 3) Crude Palm Oil Industry*. Ministry of Science, Technology and the Environment, Malasia.

Dodson, CH; Gentry, AH. s.f. Biological extinction in Western Ecuador. *Annals of the Missouri Botanical Garden*, 78 (2): 2373-295.

EPA. 2003. International Analysis of Methane and Nitrous Oxide Abatement Opportunities. *Report to Energy Modeling Forum*, Working Group, 211.

Etter, AA. 1999. Sabanas. *In:* Chaves, ME; Arango, N. (eds.) *Primer informe sobre el estado de la biodiversidad* - Inseb. Instituto Alexander von Humboldt, Santafé de Bogotá.

Etter, A.A. 1999. Mapa general de ecosistemas de Colombia. *In:* Chaves, ME; Arango, N. (eds.) *Primer informe sobre el estado de la biodiversidad* - Inseb. Instituto Alexander von Humboldt, Santafé de Bogotá.

Federación Nacional de Cultivadores de Palma de Aceite- Fedepalma. 1997. *Convenio de concertación para una producción más limpia con el subsector de palma de aceite*. Fedepalma, Santafé de Bogotá.

Federación Nacional de Cultivadores de Palma de Aceite-Fedepalma. 2003. *Anuario estadístico 2002. La agroindustria de la palma de aceite en Colombia y el mundo 1997 – 2001*. Fedepalma, Bogotá.

Federación Nacional de Cultivadores de Palma de Aceite-Fedepalma; Ministerio del Medio Ambiente; Sociedad de Agricultores de Colombia. 2002. *Guía ambiental para el subsector de la agroindustria de la palma de aceite*. Fedepalma, Bogotá.

Fee, CG; Sharma, M. s.f. *Integrated pest and disease management and associated impact of pesticides*. Chap. 5.

Fundación Futuro Latinoamericano, Instituto von Humboldt - FFLA-IVH. 2001. *Facilitación del comercio de productos y servicios amigables con el medio ambiente entre los países de la CAN, Mercosur y Chile*. FFLA, Quito.

García, JA. 1996. *Manejo de efluentes de plantas extractoras de aceite de palma, 1. arranque, operación y mantenimiento de las lagunas de estabilización*. Cenipalma, Santafé de Bogotá.

Genty, PH. 1998. Reflexiones sobre manejo integrado de plagas en plantaciones industriales de palma. *Palmas* (Colombia) 19 (3): 51-59.

Global Environmental Management Initiative - Gemi. 1994. *Benchmarking: The Primer; Benchmarking for continuous environmental improvement*, Washington DC.

Gómez, PL; Calvache, H; Munévar, F. 2000. Agronomic practices for the sustainable management of oil palm plantations in Colombia. Manuscrito.

Graedel, TE; Allenby, BR.1995, *Industrial Ecology*. Prentence may, New Jersey.

Gurmit, S; *et al.* 1999. *Oil Palm and the Environment; a Malaysian Perspective*, Malaysian Oil Palm Growers´Council.

Hassan, AA; Yeong SW. 1999. *By-products as animal feedstuffs*. Ch. 15. Sustainable field practices. Oil Palms and the Environment. Management Perspective.

Hervé, S. 2001. *The Case of Cameroon: Oil Palm Plantations, Yet Another Threat to Cameroon's Native Forests? (On line)* World Rainforest Movement, http://www.wrm.org.uy/plantations/material/oilpalm2.html

Hoof, B. van. 2001. *Los sistemas de manejo ambiental y la implementación de producción más limpia*, notas del curso introductorio, Universidad de Los Andes. Bogotá.

Hoof, B. van. 2001, *La metodología de análisis de ciclo de vida y experiencias de aplicación en América Latina*. Conferencia en la Mesa redonda para la prevención de la contaminación en México (Monterrey).

Hunt, D; Johnson, C. 1996. *Sistemas de gestión medioambiental*. McGraw-Hill/Interamericana de España, Santafé de Bogotá.

Instituto Colombiano de Normas Técnicas - Icontec. 2003. Comunicación personal. Joaquín Mejía, director programa Cyga. Marzo 2003, Bogotá.

Instituto de Hidrología, Meteorología y Estudios Ambientales - Ideam. 1998a. *El medio ambiente en Colombia*. Ideam, Santafé de Bogotá.

Instituto de Hidrología, Meteorología y Estudios Ambientales - Ideam. 1998b. *Estudio nacional del agua. Balance hídrico y relaciones oferta-demanda de agua en Colombia. Indicadores de sensibilidad proyectados al año 2016*. Ideam, Santafé de Bogotá.

Instituto Geográfico Agustín Codazzi - Igac; Corporación Colombiana de Investigaciones Agropecuarias, Corpoica. 2002. *Conflictos de uso de las tierras en Colombia*. Bogotá.

Intergovernmental Panel on Climate Change - IPCC. 2001. *Impacts, Adaptation and Vulnerability*. IPCC, Bonn.

Isaza, Juan Carlos. 2003. Comunicación personal. Subgerente de asuntos ambientales de Asocolflores. Marzo de 2003.

Instituto Alexander von Humboldt - IVH. 2000. *Biocomercio*. Instituto de Investigaciones de Recursos Biológicos, Alexander von Humboldt. Santafé de Bogotá.

Instituto Alexander von Humbold - IVH. 1998. *Biodiversidad siglo XXI. Propuesta técnica para la formulación de un plan de acción nacional de biodiversidad*. Instituto von Humboldt; Ministerio del Medio Ambiente; Departamento Nacional de Planeación - DNP; Unión Mundial para la Naturaleza- UICN; Programa de las Naciones Unidas para el Medio Ambiente- PNUMA. Santafé de Bogotá.

Instituto Alexander von Humbold - IVH. 1997. *Informe nacional sobre el estado de la biodiversidad*. Instituto Alexander von Humboldt, Ministerio del Medio Ambiente, Programa de las Naciones Unidas para el Medio Ambiente. Santafé de Bogotá.

Janicke, M; Weidner, H. (eds.). 1997. *National Environmental Policies*. Springer, Berlín.

Jorgensen, HK. 1982. *The UP Decanter-Drier System for Reduction of Palm Oil Mill Effluent*. Proc. of Reg. Wokshop on Palm Oil Mill Technology and Effluent Treatment. Palm Oil Res. Inst. Malaysia, Kuala Lumpur.

Laverde, JF. 2003. Comunicación personal. Gerente Augura Bogotá. Marzo de 2003.

Lee, RA. 2002. *Interactive design for farm conversion. Linking agriculture research and farmer learning for sustainable small scale horticultural production in Colombia*. Ph. D. Thesis Wageningen University. The Netherlands.

Lim, CF; *et al.* 1981. *Utilization of Palm Oil Sludge as concentrate Feeding of Goats*, Proc. Nat. Workshop on Oil Palm By-product Utilization, Palm Oil Res. Inst. Malaysia, Kuala Lumpur.

Lim, KH; Leng, T. 1994. Oil Palm – *An Environment Friendly Crop*. International Planters Conference 24-26: 555-558

Mazorra, MA. 2003. Comunicación personal. Director Gestión Ambiental Fedepalma. Bogotá.

McCann, KS. 2000. The diversity- stability debate. *Nature* 405: 228-233

Mesa D, J. 2000. La palmicultura colombiana de cara al 2002. *Palmas* (Colombia), 21 (número especial Tomo 2): 9 - 17

Ministerio del Medio Ambiente - MMA. 2001. *Plan de desarrollo forestal*. MMA, Santafé de Bogotá.

Ministerio del Medio Ambiente - MMA. 1999. *Políticas ambientales de Colombia*. MMA, Santafé de Bogotá.

Ministerio del Medio Ambiente - MMA. 1998b. *Programa hacia una producción más limpia: avances y perspectivas, 1995-1998*. MMA, Santafé de Bogotá.

Ministerio del Medio Ambiente - MMA. 1997. *Política nacional de producción más limpia: propuesta presentada al Consejo Nacional Ambiental*. MMA, Santafé de Bogotá.

Mora, JA. 1990. *Impacto ambiental por el establecimiento de palma africana y camarón en selva*, Costa Pacífica. Tumaco. Fondo FEN Colombia. Bogotá.

Motta-Valencia, D. 1999. Influencia de la defoliación sobre el desempeño fisiológico y productivo de la palma de aceite *(Elaeis guineensis* Jacq.*) Ceniavances* (Colombia) 62: 1 - 4.

Noss, R. 1991. *Issues of scale in conservation biology. In:* PL. Fiedler; Kain, SJ. (eds.). Conservation biology: the theory and practice of nature conservation, preservation and management. Chapman & Hall, New York.

Organization for Economic Cooperation and Development - OECD. 1997. *Economic Globalization and the Environment*. OECD, París.

OECD, 1995. *The life cycle approach: an overview of product/process analysis*, OECD/OCDE publication, nr. OCDE/GD (95)118.

Organización de las Naciones Unidas para la Agricultura y la Alimentación - FAO. 2000. *Forest Resources Assessment 2000*. FAO, Roma.

Orozco, JM. 1999 *Las políticas forestales en Colombia. Análisis de los procesos de formulación, contenidos y resultados globales*. Universidad Distrital Francisco José de Caldas, Santafé de Bogotá.

Pauli, G. 1997. *Upsizing ciencia generativa*. Instituto Zeri para Latinoamérica y la Universidad de Manizales, Manizales (Colombia).

Primavessi, A. 1997. *Agroecología*. Nobel, São Paulo.

Primavessi, A. 1980. *Manejo ecológico do solo*. Nobel, São Paulo.

Quiroga M, R. 2001. *Indicadores de desarrollo sustentable: estado del arte y perspectivas*. Cepal, Santiago de Chile.

Ramírez, J. 1998. Consecuencias ambientales del nuevo orden en el sector agropecuario colombiano. *In: Agro y medio ambiente*. Foro Nacional Ambiental, Bogotá.

Rodríguez B, M; Espinoza, G. 2002. *Gestión ambiental en América Latina y el Caribe. Evolución, tendencias y buenas prácticas*. Banco Interamericano de Desarrollo, Departamento de Desarrollo Sostenible, Washington.

Rodríguez B, M. 2002. *El futuro ambiental de Colombia*. Facultad de Administración, Serie Cátedra Corona, Universidad de los Andes. Santafé de Bogotá.

Rodríguez B, M. 1998. *La reforma ambiental en Colombia*. Tercer Mundo-FES, Santafé de Bogotá.

Rodríguez B, M; Uribe, E. 1996. *Instrumentos económicos para la gestión ambiental en Colombia*. Fescol, Cerec, Santafé de Bogotá.

Rodríguez B, M. 1994. *Crisis ambiental y relaciones internacionales*. Fescol, Cerec, Santafé de Bogotá.

Romero, CM; Moreno, AL; Múnevar, F. 1999. *Evaluación edafoclimática de las tierras del trópico bajo colombiano para el cultivo de la palma de aceite*. Corpoica - Cenipalma, Santafe de Bogotá.

Sulong, M; *et al.* 2002. *Zero effluent discharce technology for palm oil mill*, 2002 International Oil Palm Conference, Nusa Dua, Bali (Indonesia).

Súarez, PA; Ávila, FA. 2002. *Análisis y valoración de la aplicación del modelo Zeri en el subsector agroindustrial de la palma de aceite en la zona Tumaco.* Universidad Pontificia Javeriana, Facultad de Ingeniería, Departamento de Ingeniería Industrial, Cali. (Tesis)

Teoh, CH; Chia, CS. 1993. Waste or by-Product? – The Recycling Aspects of Oil Palm Cultivation and Palm Oil Processing. *In: Proceedings of the 1993 Porim International Palm Oil Congress Update and Vision,* Special joint session on Life Cycle Assesment, Ministry of Primary Industries. Malaysia.

United Nations - UN. 1992. *Report of the United Nations Conference on Environment and Development. Rio de Janeiro, 3-14 June, 1992.* UN, New York.

United Nations - UN. 1997. *Critical Trends, Global Change and Sustainable Development.* UN, New York.

United Nations -UN. 2002. *Declaración política y plan de acción de la Cumbre mundial sobre desarrollo sostenible.* UN, Johannesburg, New York.

United Nations Environment Programme -Unep. 2001. *Government Strategies and Policies for Cleaner Production.* Draft, Frane, 2001. Consultado en www.uneptie.org, noviembre de 2002.

United Nations Environment Programme - Unep. 2000. *Handbook of the Convention on Biological Diversity.* Unep, Montreal.

United Nations Environment Programme - Unep. 1998. *Selected Multilateral Treaties in the Field of the Environment.* Cambridge University Press, Cambridge.

United Nations Environment Programme - Unep. 1995. *Global Biodiversity Assessment.* Cambridge University Press, Cambridge.

United Nations Environment Programme - UNEP. 1996, *Life Cycle Assessment; what it is and how to do it,* United Nations Publication, 1th Ed. Cambridge University Press, Cambridge

United Nations Environment Programme - Unep–WBCSD. 1998. *Cleaner Production and Eco-efficiency; Complementary approaches to Sustainable development,* booklet prepared Fifth International High Level Seminar on Cleaner Production, held between September 28 and October 1, 1998, in Phoenix Park, Unep– WBSCD, (Republic of Korea).

Uribe, E. 2003. *Palma africana y suelos en Colombia.* Odes (inédito). Bogotá.

Van der Hammen, T; Andrade, GI. 2002. *La estructura ecológica principal para Colombia. Primera aproximación.* Informe Instituto de Investigaciones Ambientales - Ideam. Bogotá.

Vandermeer, J. 1991. Palma africana (palma de aceite, African oil palm). *In: Especies cultivadas.* Janzen, DH (ed.) Historia natural de Costa Rica. Organización de Estudios Tropicales. San José (Costa Rica).

Virgon, BW ; *et al.* 1993. *Life cycle Assessment: Inventory Guidelines and Principles.* US Environmental Protection Agency. Cincinnati, Ohio.

The World Bank - WB. 2000. *Greening Industry.* The World Bank, Washington.

World Business Council for Sustainable Development - WBCSD. 2002, *Sustainable Development Reporting; Striking the Balance.* Earth print, Inglaterra.

World Rainforest Movement - WRM. 2001. Issue No. 47. June 2001.

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