ENVIRONMENTAL ASSESSMENT (EA)

PROJECT:

"Regional Proposal for the Eradication of Illicit Crops by Way of Implementing an Agrosilvopastural System in the Canyon of the Anamichú River", Colombia

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Contract Number 527-C-00-01-00091-00
Colombia Alternative Development Project

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November 13, 2003

CONTRACT No CAD-CT-028-04-5
CHEMONICS INTERNATIONAL INC. –ESTUDIOS Y ASESORIAS

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FINAL REPORT

BOGOTÁ D. C., NOVEMBER 13, 2003

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SECTION 1 SUMMARY

1.1 INTRODUCTION

Preservation and Improvement of Natural Resources and the Environment in Colombia is one of the most important goals in alternative project development. To meet this goal, USAID and the Government of Colombia are looking at ways to implement programs for alternative crop development that can adapt with none or minimum impact on the Environment.

In order to verify positive environmental impacts generated during project implementation, as well as preventing negative impacts in crop activities, Chemonics hired Estudios y Asesorías, Consulting Engineers Ltd. of Bogotá to conduct an Environmental Assessment of the project for implementation of a multipurpose farming system[1] (*known as Agrosilvopastural system in Spanish*) in the Canyon of the Anamichú River in the Department of Tolima.

1.2 OBJECTIVES

The main objective of this study is to analyze the physical, biotic and socioeconomic aspects in the area of influence of the project for the purpose of identifying and evaluating the impacts caused by the implementation and operation of the project. The study establishes environmental, monitoring and management measures to guarantee sustainable development of the project, both during the development phase and upon termination of activities. The objective of the Study includes a comprehensive discussion of the consequences of the implementation and management of the productive characteristics of crops and their repercussions on the environment, to assist project officers in decision making processes.

1.3 PROJECT DESCRIPTION

1.3.1 Location

The project "Regional Proposal for the Eradication of Illicit Crops by way of Implementing an Agrosilvopastural System in the Canyon of the Anamichú River" is located in the southwest of the Department of Tolima, in the Municipality of Rioblanco, *veredas* (or rural divisions) of Alfonso Carrillo, La Catalina, La Playa, La Albania, Yarumales and La Legía.

To arrive at the project area, one starts at the urban township of the Municipality of Rioblanco, heading towards Gaitán, which is approximately 33 km away along an unpaved, relatively fair road. From there, one follows the horse trail along the left

[1] **An Agrosilvopastural System is a Multipurpose Farming Project, involving agriculture, animal nursing, and forestry related to the plantation of leguminous species apt for animal feeding.**

margin of the Anamichú river to arrive at the *vereda* La Playa, after 8 to 10 hours on horseback.

The project includes developing 300 ha of various crops, using an agrosilvopastural system approach, as follows :

- Organic – Coffee + timber 60 ha
- Silvopastural Cedar - Romeron Pine System, 60 ha
- Tall Grass (for cattle rising) 60 ha
- Beans, garlic, corn, "Achira" and pea crops 60 ha
- Coffee + Walnut , 60 ha

The project provides participating families with 240 calves (2 per family), and 20 chickens for each one of the 120 families, who agreed to voluntary eradication of 300 ha of poppy crops. Two predominant systems in the canyon, based on the so called "zones of life", have been proposed, as follows:

- Humid Premontainous Forest zones (Bh-pm), between 1,700 mosl (meters over sea level) and 2,000 mosl, are designated for eradication of 2.5 ha of poppy crops, per each agricultural unit (family), to be substituted with 1 ha of organic coffee, 1 ha of high-grade coffee and walnut, and 0.5 has for various food-crops that will generate additional food supply and income in the short and medium term, such as beans, peas, vegetables, chickens, tall grass and two calves.

- Low Mountainous Forest (Bh-pm) located between 2,000 mosl and 2,500 mosl, also designated for the eradication of 2.5 ha of poppy, per agricultural unit, with 1 ha of "credo" o Romeron pine, and 1.5 ha divided in two crops including tall grass, garlic, "Achira", chickens, vegetables and two calves.

1.3.2 Project Activities

The altitudinal fringe where the Anamichú project is to take place, is an area that has been floristically altered for many years, as can be seen in aerial photographs of the *veredas* that make up the project. However, the proximity of the project to the National Park of Las Hermosas means that the project must guarantee that Agrosilvopastural activities will not generate any further biological deterioration to the Hermosas Park, under GOC environmental protection.

The project zone is located in the Anamichú river canyon between 1,500 and 2,500 mosl, bordering with the *páramo* highlands at 3,000 mosl. This characteristic, and specially the fact that the zone is an area of exclusion not delimitated clearly, generates some problems particularly in the incorporation of cattle to the project (395 heads) that could affect the 500 m buffer zone, located, theoretically, between 2,500 and 3,000 mosl).

1.3.3 Agricultural Management

The seedling nurseries must be installed in January so the plants can be transported to the final site in September, the best time of year to plant in the southern part of Tolima. Coffee plots must be outlined according to the inclination of the slopes, following level contours,. Corn, peas, "achira", garlic, vegetables and bean crops should be planted in areas as flat as possible. Removal of weeds is also recommended.

The planting season correspond to the second semester, coinciding with the rainy season, at the end of September and beginning of October; however, transition crops may be planted at during any time of year. The sowing techniques recommended for peas, (*Pisum sativum*) and beans (*Phaceolus vulgaris*) are simple shoulder type; for garlic (*Allium sativum*), the sowing is in multiple lines generally 1.2 to 1.5 m wide, 15 cm high, with a 42 cm ditch for separation.

For the "Achira" planting (*Canna edulis*), the best time of year is at the beginning of the rainy season during the months of September and October, using separation of 0.8 m between plants and 1 m between mounds.

Post-harvest activities in coffee farming include:

- Selection of coffee post-harvest: Only ripened beans may be collected to yield higher income, best quality "*pergamino dry*" coffee. This will also reduce infestations by "*broca*" an endemic coffee blight, that could make up for as much as 10% loss in crop yield.
- Transportation of coffee beans to processing sites: In sloping terrain, beans are transported thru cement or wood channels down-slope, or in covered tin containers.
- Pulp separation: Must be done in dry conditions.
- Bean grade classification : Sieve classifiers must be used.
- Bean fermentation: use mechanical systems or fermentation tanks to decompose the mucilage that covers the coffee bean, dissolving it in water and disposed by washing. This process takes between 18 to 30 hours, depending on weather
- Bean washing: use with clean water and recycle to reduce the costs.
- Drying: Can be done naturally or artificially. Solar energy is the most common, and cheapest, system to dry coffee beans, utilizing drying carts or terraces to expose the grain to sun and the wind. Artificial drying is done in special electrical or fuel oil-powered driers.

For other crops (beans, peas, corn, garlic), the harvest and post harvest activities are limited to selection and packaging of products, which requires no special handling. The sub-products (mostly pulp), must be transported (and dehydrated if possible) to storage sites or decomposition sites, these may be a pond, or cement box, or to worm compost beds. Recycled pulp and compost is for fertilization of seedlings, or applied to crops as nutritional complement, or to improve soil conditions. Solid waste from leaves and stems leftovers after harvesting beans, peas, corn and garlic crops. This organic material is used to fertilize and improve physical condition of soils.

Liquid waste represented mostly by mucilage leftovers and water used during the coffee process, can be recycled to be used as crop fertilizer; mucilage can be added to enrich pulp, or taken to worm nurseries, and in some cases, it can be used as pet and domestic animal feed.

1.3.4 Stock Management

The use of pastures for cattle growing is not recommended. Farmers are advised to adopt stock confinement stabled systems. In small areas, the use of stable systems can be implemented through cultivation of tall grass. Another animal feed is the foliage of the "*achira*" plant, which has produced good quality for animal consumption.

Chickens and domestic fowl farming can also be done in sheds or corrals to facilitate bird's handling. Fowl feed must be placed in feeders, along with water containers. Barn, corral or shed floors should be designed to facilitate cleaning, and eliminate odors thus reducing the risk of infections.

1.4 ENVIRONMENTAL ASSESSMENT

1.4.1 Area of Influence of the Project

The Indirect Area of Influence of the project includes areas planted with poppy throughout the Anamichu river canyon. These areas include the main project social component, prone to negative effects, not necessarily caused by the project. Geographically, it comprises the municipality of Rioblanco, and the area of the Las Hermosas Natural Park.

The direct area of influence of the project comprises the veredas Alfonso Carrillo, La Catalina, La Playa, La Albania, Yarumales and La Legía.

1.4.2 Physical and Biotic Components

The Project area belongs to the sub Andean forest system, a humid isothermal forest, with temperatures ranging from 14 ºC to 24 ºC; it is also classified as tropical forest and humid, very humid and rainy Pre-montainous and low-mountainous thermic floors.

The structural characteristics of the forest represent a complex composition of species of trees, bushes, palms, shrubs and herbs; most of the tree species in the region are valuable woods. To day, this forest is subject to severe anthropic pressures due to widespread deforestation for cultivation of illicit crops like poppy, at the 2,500 m level.

Intervention of forests in the Anamichú canyon has been done in patches, destroying wildlife habitats; however, in some areas, especially towards the highest parts of the canyon, it is possible to see patches of vegetation which still serve as refuge to wildlife and as escape corridors to animals descending from the Páramo of the Hermosas in search of food.

The flora and fauna of Las Hermosas is in good condition, while wildlife habitats in the project zone are highly deteriorated as result of massive deforestation to make room for planting illicit crops. Floral species recommended for coffee shade and for reforestation of areas intervened, are endemic to the region and found in natural environmental state throughout the Anamichú canyon.

1.4.3 Social Component

The 120 families that joined the voluntary illicit crop substitution program are residents of the six *veredas* of the project, and traditional farmer families living in the project area. The need to increase family incomes and improve living conditions prompted these families to plant poppy in the first place, no other alternatives were available. Social problems like fathers abandoning homes, children and women becoming uncared for, male dominance and disregard for family economic support, rampart drinking, prostitution, gambling, wife and children abuse constitute part of the poppy culture. Few families could save money, or invest for that matters.

Housing construction is characterized by predominant "*bahareque*" or waddle walls, pressed mud is a common building material, along with cement floors and galvanized roofing. This problem becomes critical if more than one family inhabits the house.

1.5 ASSESSMENT OF ALTERNATIVES

Identification of potential future changes in the environment, is and important tool to assist sustainability analyzes. Two alternatives were reviewed in regards to character, magnitude and time within potential alterations that could be caused on environmental project components, i.e., to considering or not consider the implementation of the EMP for the project. The following alternatives, include two options for decision making:

- The No Action Alternative: the project should not be developed due to negative impact potential; and

- The Preferred Action Alternative: the project may go ahead applying the EMP.

This section examines the Assessment and performance of natural resources during the execution of the project, with and without the implementation of the measures of the EMP.

1.5.1 Methodology

The same method of matrix assessment that was used to run the environmental assessment of the project is used to simulate behavior of the different impacts identified during the activities of the project over time, under two different alternatives which are described below:

ALTERNATIVE 1 : This alternative describes the behavior of environmental resources as the productive project is implemented parallel to the execution of the measures established in the EMP.

ALTERNATIVE 2 : This alternative considers the behavior of resources towards the future, considering that the project continues to develop under the same natural conditions that exist today, with the prevailing social realities and no specific environmental measures applied to ensure project sustainability.

Once the basic alternatives that permit the assessment are known, it is possible to choose a scale for doing the assessment in the following manner:

- Character: Positive, (Beneficial), or Negative, (Adverse), according to the type of consequences that can be derived in absence of the measure.
- Incidence: related to the way in which an action of the EMP is carried out or not, acting over the resource through the identified impact. It has been graded as High, Medium, or Low.
- Duration : related to time elapsed between the application or no application of the measure, and the moment in which the effects can appear on the resource, be them adverse or beneficial. This parameter has been valued for three types of periods: Long-term, (if greater than three years), Medium-term, (between 1 and 3 years), and Low-term, (below 1 year).
- Scope: Determines if the action is applied in the direct area of the project (local), or if it encompasses a larger or regional space (regional).

The grading scale below allows subjective grading according to the criteria of annalists, for employees, or management, as shown below:

Table 1. Quantification of Conditions of Alternatives Analyzed

Criteria for classification	Qualitative valuation	Quantitative valuation
Character of Impact	Positive	+
	Negative	-
Incidence	High	3.0
	Medium	2.0
	Low	1.0
Duration	Short	1.5
	Medium	1.0
	Large	0.5
Scope	Local	0.40
	Extensive	0.60

The definition of criteria was made jointly with the specialists participating in the study at joint meetings, to establish the scales for assessment of future conditions of the project according to the different environmental resources affected in each of the Alternative's Analysis described. For each alternative, the Assessment results from the addition of the qualifications of the different impacts, to obtain the corresponding measurement of environmental quality, (EC), as follows:

$$EC = I + P + A \qquad \textbf{(1)}$$

Once the EC values are calculated for each alternative, the value of EC to the future is computed by adding these qualifications with those obtained for the present condition of the project, as indicated by equations (2) and (3). In order to establish the relation between values of Environmental Qualification, "EC", and Environmental Alteration levels, (EA), the same range of values of EA, which can be related both for positive and negative impacts by entering the amounts of EC as absolute values.

$$EC_{future} = EC_{present} + EC_{with\ EMP} \qquad (2)$$

$$EC_{future} = EC_{present} + EC_{without\ EMP} \qquad (3)$$

1.5.2 Method of Calculation

The formula in equation (1), applied for example, to the potential impact of air pollution, incorporates several items of analysis like: cleaning of the land, application of agrochemicals, landslides on hillsides from irregular farming practices, the lack of formation and of technical assistance, led to the impact being quantified as in the following table:

Table 2. Quantification of Impacts Identified

IDENTIFIED IMPACTS		PROJECT WITH EMP								PROJECT WITHOUT EMP								ENVIRONMENTAL QUALIFICATION EC	
		INCIDENCE			DURATION			SCOPE		INCIDENCE			DURATION			SCOPE		WITH EMP	WITHOUT EMP
		3.0	2.0	1.0	0.5	1.0	1.5	0.4	0.6	3.0	2.0	1.0	0.5	1.0	1.5	0.4	0.6		
Air Pollution due to cleaning of the land, Application of Agrochemicals and other activities (1)	1			1.0	0.5			0.4				-1.0		-1.0		-0.4		1.9	-2.4
Landslides in Sloping Areas (2)	8		2.0				1.5	0.4			-2.0				-1.5	-0.4		3.9	-3.9
Formation and Technical Assistance (3)	27		2.0				1.5	0.4		-3.0					-1.5	-0.4		3.9	-4.9

1.5.3 Final Results

Table 3. Summary of Environmental Assessments

AFFECTED ENVIRONMENTAL RESOURCE	PRESENT CONDITION	ALTERNATIVE WITH EMP	ALTERNATIVE WITHOUT EMP
AIR	-1.2	1.5	-4.3
WATER	-3.2	0.3	-7.0
SOIL	-3.4	0.1	-7.1
FLORA	-2.2	0.8	-5.4
FAUNA	-1.8	1.0	-4.8
SOCIOECONOMIC	3.0	7.0	-1.4

According to the previous table, the environmental resource most affected by project activity, without the EMP measures, is soil, (-7.1), and even if mitigation measures were applied, the resource would not recuperate in full, particularly considering the impacts generated by scouring along gullies and poor drainages near planting sites. The resource negatively affected that follows next is water (-7.0), due to deterioration of water quality from potential drainage alterations and use of pesticides. Flora is also affected (–5.4),due to the disappearance of valuable species if deforestation and illicit crop cultivation, and use of pesticides continue.

The social component, in case the measures of the EMP are not carried out, could have a negative effect, due mostly to lack of a monitoring and follow up system, albeit of low impact, since the project seeks to mitigate a social problem with substitution of illicit cultivation through an agricultural activity that allows for the subsistence of the community and an improvement of the living conditions, an objective that can easily be reached, even without the implementation of the EMP.

It is evident, however, that the benefits of implementing an EMP are the greatest (7.0), since this is the key to project and natural resources sustainability in the future.
An important impact, as shown above, is the potential for natural deterioration due to the use of agrochemicals, especially pesticides. Regulation 216 requires that a PERSUAP be carried out for each chemical used, or to possibly be used; as a follow through, an Integrated Pest Management Plan (IPM) was incorporated for each chemical, so that natural, non-chemical means of pest control can be viable options for the farmers. Due to the fact that the pesticide analysis is a full chapter, a summary is presented below that defines some of the main objectives, however the IPM options will not be discussed here, but can be found in the PERSUAP section of this study.

- Products not registered in the US and Colombia or in PIC[2] list. NOT TO BE USED UNDER ANY CIRCUMSTANCE: captafol, isazofol, methyl parathion and methamidophos.

[2] 'PIC List' is the Prior Informed Consent List of the Rotterdam Convention, led by UNEP and FAO, that applies to the international shipment of the most hazardous chemicals.

♦ Products not yet registered in the US or Colombia. Although a microbial product, the first, and a plant extract, the second, they are NOT TO BE USED UNTIL REGISTERED in at least Colombia: *Baculovirus spodopterae* and *Swingla* (extracts).

♦ Products not registered in Colombia. NOT TO BE USED UNDER ANY CIRCUMSTANCE: endosulfan.

♦ Products not registered with USEPA. NOT TO BE USED UNDER ANY CIRCUMSTANCE: benzimidazole, hexaconazole, kasugamicine, monocrotophos, and ofurace.

♦ Products not registered w/USEPA. But registered in Colombia. APPROVED TO BE USED: extracts of *Glyricidia sepium*, because the resource (*Glyricidia*), the crop (vanilla) and the pest (*Cylsia*), are not present in the US; *Paecilomices liacinus*, because the crop (heart of palm) and the pest (*Leptopharsa*) are not present in the US and the pesticide is a microbial insecticide with unlikely environmental or health impact; and *Trichogramma pretiosum* and *Verticillium lecanii*, are both microbial insecticides with unlikely environmental or health impact.

♦ Products are RUP with USEPA. NOT TO BE USED: aldicarb, cyalothrine (lambda) cyfluthrin, chlorothalonil, chlorpyrifos, copper oxychloride, cypermethrine, methomyl, paraquat, profenofos

♦ Products are RUP[3] with USEPA. USE ONLY CERTAIN FORMULATIONS to reduce health or environmental risk: carbofuran (pellets/tablet), and picloram (Tordon 101R).

1.6 ENVIRONMENTAL IDENTIFICATION OF IMPACTS

1.6.1 Methodology

The methodology for identifying environmental impacts is based on the Leopold matrix for Environmental Assessments, which contains the potentially vulnerable environmental factors and correlates them with every phase of the project's activities, presenting both (as columns and lines) in an impact identification matrix. Each impact could be adverse if project activity alters the natural negatively, or it could be positive if the impact is beneficial. The criteria used to determine the natural resources environmental assessment, include: nature of the impact, type of impact, duration, scope, tendency, synergy, and probability of occurrence and magnitude.

[3] RUP: Restricted Use Pesticide.

1.6.2 Results

Based on the matrix, project activities are classified in a vertical pattern according to the degree of negative effects generated on the environmental components under review. Farming activities, including cultivation and processing, are categorized from low to high negative affectations, as follows:

- **Farming**: including seedling preparation, have the greatest negative ratings, followed by corral and shed management, then pest control. There are also beneficial impacts activities like germination, transplantation, weed control, irrigation and fertilization. The production phase of the project presents most of the beneficial interactions.

- **Soil*:*** The most important effect is scour; formation of gullies, and drainage channels, followed by the loss of soil due to improper cultivation practices, and contamination of soils with agrochemicals.

- **Air*:*** the interactions indicate lesser effects than those of other resources; the cause could be air pollution from soil cleaning and during the application of agrochemicals; also the generation of odors by the application of agrochemicals.

- **Biotic environment*:*** the most negative interaction deals with deforestation, followed by loss of valuable fauna species from toxicity by agrochemical compounds, followed by the destruction of wild habitats for fauna and endangered species.

- **Socioeconomic environment**, the interactions reflect the beneficial character of the project, since most of the balances yield positive values. The most significant of them are existences of technical training and assistance, institutional following, food security, entrepreneurial expertise and environmental education.

As a conclusion it is evident that adverse interactions with the environment are due solely to the lack of an environmental management plan, monitoring and follow-up plan. This allows the experts to conclude that the preferred option is to continue the project following the strategic outlines of the EMP and EMFP.

1.7 ENVIRONMENTAL ASSESSMENT MATRIX

1.7.1 Methodology

The environmental assessment favors continuing the Anamichú Project, using as an analytical baseline the ecological prevalent conditions in the southwest portion of the Department of Tolima, in the municipality of Rioblanco. Important criteria are applied

for the assessment, are: geographical location, hydrology, climate, existing infrastructure, productivity and land aptitude. The values relating to quality and quantity are established using the same formulas as the environmental quality (EC) parameters which can be correlated using the indicators.

1.7.2 Results

Productive project components generate effects over the biological, physical and socioeconomic components, as shown above. Permanent crops have common tasks like germination, seedling procreation, hole making, layout, drainage construction and transplantation. Most other crops are cultivated directly and the common tasks are land preparation, drainage construction, weed control, pest and disease control, irrigation, fertilization, harvesting and post harvesting, recollection, transport and elimination of the remaining roots. In the case of coffee (permanent crop), the processing must be included (discarding pulp, fermentation, washing and drying) because of its potential environmental impacts.

The effects caused by coffee processing were identified and are the cause of mayor impacts on the biological and physical environments, due to several activities that are part of the process and generate contamination of water, soil and air.

Other crop related impacts include use and handling of agrochemical products although the project's conception is directed to the development of organic agriculture, avoiding the utilization of chemicals both for fertilization and pest control.

Another aspect of importance is the identification of impacts related to water and soil contamination due to inadequate handling of solid residues, (pulp, chicken and stock manure), resulting from coffee processing and cattle raising.

The resource that presents the most adverse environmental alteration is soil, mostly as related to scour in gullies or drains adjacent to cultivated fields and contamination of the soil because of poor disposition of solid waste from corrals and sheds.

In descending order, the affectation on the water resources is caused by the activities that compromise water quality such as alteration of drainage, due to characteristics of terrain, high slopes, and contamination with sediments from land alteration and use of agrochemicals.

In regard to biotic resources, flora and fauna, the greatest impact results from possible affectation of valuable animal and vegetation species or endangered species, in the buffer zones of the Las Hermosas natural park.

In regards to air, the greatest affectation relates to generation of odors due to the management of corrals and sheds, during the operating phase of the project.

The beneficial alteration of the project is exercised over the socioeconomic environment, in which most of the positive EC values were reported. The EC values registered corresponding to a medium low environmental alteration.

Finally, it can be said that the environmental assessment of the different phases that conform the Multipurpose Anamichú Project shows that, although some of these activities are producing impacts on the environment, the affectation can be diminished with the implementation of the EMP, which considers the measures needed to counter these effects and increase the social benefits that are being produced. In this manner, it is expected that the Environmental Quality will improve with the implementation of the EMP, with a corresponding increase on the social benefits from the project towards the community and the environment.

1.8 ENVIRONMENTAL MANAGEMENT PLAN - EMP

1.8.1 Environmental Guidelines

The Environmental Management Plan's measures include programs and mitigating activities to attend to specific factors that generate environmental impacts, as well as follow-up strategies. Each measures is presented according to the following criteria: type, objective, impacts to control, spatial coverage or location, designs, description of the measure(s), schedule and costs.

The measures that conform the Environmental Management Plan include :

- Soil management, through proper cultural and agronomic practices, which range from pesticide, weed and erosion control to better land cleaning techniques, hill contour farming and erosion controls;
- Soil and water preservation through adequate solid waste disposal, avoiding harmful soil preparation practices, and adopting strict management control of chemicals used throughout the project.
- Water management through control of sheds and corrals, and water quality monitoring of streams.
- Preservation of flora and fauna through protection and regulation of plant material use, reforestation plans and hunting controls;
- Renewal of vegetation by adequate cover management, floristic compensation with planting of live fences and plantations of endemic species.
- Education on means to avoid fauna migration.
- Ecosystem protection and conservation of native ecosystems, especially the Natural Park Las Hermosas.
- Organic and biological agricultural practices.
- Social Management, through environmental education, training and technical assistance, park rangers, supporting infrastructure, ordering of the watershed, training of leaders and education in food safety.

1.8.2 Environmental Monitoring And Follow Up Plan

The Environmental Monitoring and Follow-up Plan -EMFP- is part of the environmental management plan –EMP- and constitutes a management tool with detailed programs and mechanisms, including impact identification all the way to components that allow for verification, vigilance and assessment of the actions and activities of the project before, after and during its execution.

The EMPF establishes in detail the indicators and the places where the monitoring should take place, as well as the methodologies recommended in particular for sampling and verification, including periodicity of sampling, duration, type of analysis, forms of assessment, costs and financing of the activities. The EMFP includes recommendations regarding the form for presenting periodic reports, with argumentation of the periodicity of reporting and will establish the extent of advances on aspects such as: physical and chemical monitoring of intervened watersheds, reforestation programs and erosion control, biological control, solid waste and social welfare management.

The general objective of the EMFP, is to provide the Environmental Authorities the community, Chemonics and USAID with a technical basis for verifying the correct development of the project.

The EMFP will establish the activities that are necessary to implement via the EMP, as well as those responsibilities that are necessary for verification, vigilance and Assessment of the activities of the Plan.

The Plan details the indicators and places where the monitoring should take place, as well as the methodologies recommended, particularly for sampling and verification, including periodicity of sampling, duration, type of analysis, forms of Assessment, costs and financing of the activities. The sampling points were established using as a basis those that were utilized for the Environmental Assessment, in order to increase the confidence in the results and run comparative Assessments.

The Plan will include recommendations regarding the form for presenting periodic reports, the times of reporting and will establish percentage of advances on aspects like: physicochemical monitoring on intervened water bodies, reforestation and erosion control programs, biological control programs, solid residue management programs and social welfare management programs.

1.8.3 Environmental Leadership Plan

Environmental policy provides the necessary planning information and is designed taking into account the results of the Environmental Assessment. It is necessary to create an organizational structure for defining program direction, coordination and execution system and to provide economic and physical resources, to generate procedures, communication flows and operational controls.

The follow-up phase corresponds to verification of the effectiveness and efficiency of the environmental measures adopted. It is supported on actions such as monitoring and determination of the characteristics of the operations and of the key activities that cause environmental impacts, as well as definition of responsibilities and instruments required to handle, investigate and correct nonconformities, keeping environmental registers to probe the fulfillment of objectives and goals and carrying out environmental auditing in order to determine if the EMP has been correctly implemented and meets planned objectives.

It is suggested that an Environmental Management Unit is created to implement the Environmental Administration System. This unit would be responsible for supervising the environmental management measures executed and the EMFP, in accordance with the recommendations given in this study.

1.8.4 Costs

Costs for the EMFP have been estimated according to the methodology proposed in the Technical Cards of the EMP. This means that the EMFP adds costs to each EMP activity. The costs of the EMFP included are those related to sampling and laboratory analysis of water and soil quality, the direct costs of photographic records and the elaboration of reports. The estimated cost of the Environmental Management Plan Costs is COL$458,479,410 (US$163,743).

SECTION 2 PURPOSE

2.1 GENERAL PURPOSE

The main objective of this study is to analyze the physical, biotic and socioeconomic aspects in the area of influence of the project for the purpose of identifying and evaluating the impact of implementation and operation of the project "Regional Proposal for the Eradication of Illicit Crops by implementing the Agrosilvopastural System in the Canyon of the Anamichú River", located in the south west of the Department of Tolima, in the Municipality of Rioblanco, veredas (or rural divisions) of Alfonso Carrillo, La Catalina, La Playa, La Albania, Yarumales y La Legia.

The study will establish the relevant environmental monitoring and management measures that will guarantee sustainable development of the project both during its beginning as well as after it is abandoned. The final goal of the activities is supplying project authorities in charge of decision making with full information of the consequences of implementation and management of the productive characteristics of the project and their repercussions on the environment.

The scope of the project includes the following aspects:

- Elaboration of an environmental diagnosis, including relevant specific aspects of the current operation, and projections for implementing the several crops.

- Elaboration of an environmental Assessment, according to the methodology of the Leopold Matrix, which will identify the different impacts, valuate the degree of damage and propose adequate environmental management measures.

- Formulation and description of preventive, mitigating, corrective and/or compensatory measures required harmonize the physical, biotic and socioeconomic environment with the project. These measures will include aspects such as objectives, goals, expected results, design criteria, typical blueprints, human resources, execution timetable, budget and responsibilities.

The project Environmental Assessment followed the methodology used by the Consultant in similar studies in Colombia and the guidelines of Chemonics, as well as those of the Natural Resources and Environmental section of USAID. Initially, the Consultants reviewed the existing information and visited the area to obtain a first hand characterization of the present environmental conditions of the area of influence of the project, trying to involve the community as much as possible, by visiting their houses and inviting them to meetings with the local operative agencies and community organizations whom will benefit from the project.

The present Environmental Impact Study was accomplished within the terms of Regulation 216-c of USAID and Colombian environmental legislation. The study also contemplated the politics and guidelines for development of the municipality of Rio Blanco, according to its Plan de Ordenamiento Territorial, (P.O.T.), which was frequently consulted during the study.

2.2 METHODOLOGY

The study was developed on the basis on the methodology accepted by the state environmental organizations and basically include the following aspects : Identifying areas of direct or indirect influence; Technical description of the prospective project; Characterization of the environmental base line on the physical, biotic, social, cultural and economic aspects; on site identification of the impacts generated by the project. Contact with the community was maintained during the fieldwork, through direct involvement with the population working in the project, and the participation of community organizations, which were included to maintain a high level of approval of the project.

The work included field activities involving gathering of primary information and office activities involving processing and analysis of primary and secondary information related to the area of study. The information was employed in the identification and impact Assessment stages of the project and in the formulation of environmental monitoring and follow up plans.

SECTION 3 ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 INTRODUCTION

As a complement of the assessment phase of the agricultural project, it is convenient to establish the behavior of the environment into the future, in order to be able to judge its sustainability. For this purpose, two alternatives were analyzed to evaluate the character, magnitude and time within which alterations are caused over each one of the environmental elements, and looking into the future, considering or not the implementation of the EMP for the project. This is equivalent to performing a Diagnostic of Environmental Alternatives for the continuing realization of the Project. The present chapter thus deals with the assessment considering the two alternatives, with and without the implementation of the measures contained in the EMP

The project "Regional Proposal for the Eradication of Illicit Crops by Way of the Implementation of an Agrosilvopastural System in the Canyon of the Anamichu River", contemplates production in various different types of soil and climate, found in the canyon of the Anamichu river. Two predominant ecosystems in the canyon, based on the so called zones of life, are:
The project provides participating families with 240 calves (2 per family), and 20 chickens for each one of the 120 families, who agreed to voluntary eradication of 300 ha of poppy crops. Two predominant systems in the canyon, based on the so called "zones of life", have been proposed, as follows:

- Humid Premontainous Forest zones (Bh-pm), between 1,700 mosl (meters over sea level) and 2,000 mosl, are designated for eradication of 2.5 ha of poppy crops, per each agricultural unit (family), to be substituted with 1 ha of organic coffee, 1 ha of high-grade coffee and walnut, and 0.5 has for various food-crops that will generate additional food supply and income in the short and medium term, such as beans, peas, vegetables, chickens, tall grass and two calves.

- Low Mountainous Forest (Bh-pm) located between 2,000 mosl and 2,500 mosl, also designated for the eradication of 2.5 ha of poppy, per agricultural unit, with 1 ha of "credo" o Romeron pine, and 1.5 ha divided in two crops including tall grass, garlic, "Achira", chickens, vegetables and two calves.

It is important to note that, prior to the project's development , the main crop in the zone is Poppy. The impact of poppy on the Natural Park Las Hermosas is visible from the air. Illicit crops also deteriorate social relations. The existing baseline is not a pacific scenario of forest and forest-dwellers; instead, this is an area of severe social and environmental corrosion.

3.2 METHODOLOGY

The same method of matrix assessment that was used to run the environmental assessment of the project is used to simulate behavior of the different impacts identified during the activities of the project over time, under two different alternatives which are described below:

ALTERNATIVE 1 : This alternative describes the behavior of environmental resources as the productive project is implemented parallel to the execution of the measures established in the EMP.

ALTERNATIVE 2 : This alternative considers the behavior of resources towards the future, considering that the project continues to develop under the same natural conditions that exist today, with the prevailing social realities and no specific environmental measures applied to ensure project sustainability.

Once the basic alternatives that permit the assessment are known, it is possible to choose a scale for doing the assessment in the following manner:

- Character: Positive, (Beneficial), or Negative, (Adverse), according to the type of consequences that can be derived in absence of the measure.
- Incidence: related to the way in which an action of the EMP is carried out or not, acting over the resource through the identified impact. It has been graded as High, Medium, or Low.
- Duration : related to time elapsed between the application or no application of the measure, and the moment in which the effects can appear on the resource, be them adverse or beneficial. This parameter has been valued for three types of periods: Long-term, (if greater than three years), Medium-term, (between 1 and 3 years), and Low-term, (below 1 year).
- Scope: Determines if the action is applied in the direct area of the project (local), or if it encompasses a larger or regional space (regional).

The grading scale below allows subjective grading according to the criteria of annalists, for employees, or management, as shown below:

Table 4. Scale for Quantifying Conditions of Assessed Alternatives

CRITERIA FOR CLASSIFICATION	QUALITATIVE VALUATION	QUANTITATIVE VALUATION
Character of Impact	Positive	+
	Negative	-
Incidence	High	3.0
	Medium	2.0
	Low	1.0
Duration	Short	1.5
	Medium	1.0
	Large	0.5
Scope	Local	0.40
	Extensive	0.60

The definition of criteria was made jointly with the specialists participating in the study at joint meetings, to establish the scales for assessment of future conditions of the project according to the different environmental resources affected in each of the Alternative's Analysis described. For each alternative, the Assessment results from the addition of the qualifications of the different impacts, to obtain the corresponding measurement of environmental quality, (EC), as follows:

$$EC = I + P + A \qquad \textbf{(1)}$$

Once the EC values are calculated for each alternative, the value of EC to the future is computed by adding these qualifications with those obtained for the present condition of the project, (figure 5.1), as indicated by equations (2) and (3). In order to establish the relation between values of Environmental Qualification, "EC", and Environmental Alteration levels, (EA), the same range of values of EA, which can be related both for positive and negative impacts by entering the amounts of EC as absolute values.

$$EC_{future} = EC_{present} + EC_{with\ EMP} \qquad (2)$$

$$EC_{future} = EC_{present} + EC_{without\ EMP} \qquad (3)$$

In order to establish the relation between values of Environmental Qualification, "EC", and Environmental Alteration levels, (EA), the same range of values for EA were used.

Table 5. Absolute Values and Environmental Alteration Rating

Absolute Value of Environmental Quality	Environmental Alteration
>10.0	**Very High**
8.0-10.0	**High**
6.0-8.0	**Medium Heigh**
4.0-6.0	**Medium**
3.0-4.0	**Médium Low**
1.0-3.0	**Low**
<1.0	**Very Low**

The values of the preceding table can be related both for positive and negative impacts by entering the amounts of EC as absolute values.

Table 6. Summary Assessment of Identified Interaction for Implementation of EMP of Air Resources – Multipurpose Anamichú Project (Department of Tolima)

	PRESENT CONDITION		ALTERNATIVE WITH EMP		ALTERNATIVE WITHOUT EMP		DESCRIPTION OF QUALIFICATION
	CA	AA	CA	AA	CA	AA	
AIR	-1.2	Low	1.5	Low	-4.3	Medium	At present this element does not present critical Alteration; it is in fact low, produced mostly by generation of odors due to poor management of barns and corrals; implementation of the measures in the EMP will minimize affectations over this component, turning the EC value to 1.5, meaning a beneficial impact. Continuation of the project without implementation of EMP will clearly contribute to deterioration of air quality in the project zone, turning the rating to medium low.

Table 7. Summary Assessment of Identified Interaction for Implementation of EMP of Water Resources – Multipurpose Anamichú Project (Department of Tolima)

	PRESENT CONDITION		ALTERNATIVE WITH EMP		ALTERNATIVE WITHOUT EMP		DESCRIPTION OF QUALIFICATION
	CA	AA	CA	AA	CA	AA	
WATE	-3.2	Medium Low	0.3	Medium Low	-7.0	Media Alta	This component at present in the zone shows at present medium low Alteration. The implementation of the control and mitigation measures in the EMP will turn this variable into a beneficial impact, almost totally mitigated. The condition towards the future without the implementation of the EMP will make deterioration more critical, (-7.0), due to the effects on water quality of drainage alteration in the zone. It is worth noting that water treatment proposed in the EMP do not totally control water pollution, although the quality of the waste water will fulfill the existing normativity (Decree 1594/94 for water utilization).

Table 8. Summary Assessment of Identified Interaction for Implementation of EMP of Soil Resources – Multipurpose Anamichú Project (Department of Tolima)

	PRESENT CONDITION		ALTERNATIVE WITH EMP		ALTERNATIVE WITHOUT EMP		DESCRIPTION OF QUALIFICATION
	CA	AA	CA	AA	CA	AA	
SOIL	-3.4	Medium Low	0.1	Medium Low	-7.1	Media Alta	The implementation of environmental measures in the EMP generate improvement in the soil conditions in the zone bringing about increase productivity of crops. It is worth noting that this component is at present being affected mostly by scouring along gullies and drains, contamination by inadequate disposal of waste from barns and corrals, and landslides in sloping zones. Lack of implementation of the measures in the EMP will generate a considerable increase in the deterioration of this component, which will be reflected in the acceleration of the process of detriment in the productive capacity of the soils, affecting the crops..

Table 9. Summary Assessment of Identified Interaction for Implementation of EMP of Flora Resources – Multipurpose Anamichú Project (Department of Tolima)

	PRESENT CONDITION		ALTERNATIVE WITH EMP		ALTERNATIVE WITHOUT EMP		DESCRIPTION OF QUALIFICATION
	CA	AA	CA	AA	CA	AA	
FLORA	-2.2	Low	0.8	Medium Low	-5.4	Medium	At present, Alteration of this resource is low, and mostly related to the elimination of valuable species, particularly when considering the increase in the agricultural frontier, including the buffer zone of the Natural Park of Las Hermosa. With the implementation of the measures of the EMP this affectation is greatly mitigated, and the affectation on the Park is prevented; the alteration however, can not be totally eliminated, considering that most land has had a great anthropic intervention. Continuing the project without implementation of the measures in the EMP will contribute greatly to the deterioration of the resource, transforming the Alteration from low to medium.

Table 10. Summary Assessment of Identified Interaction for Implementation of EMP of Fauna Resources – Multipurpose Anamichú Project (Department of Tolima)

	PRESENT CONDITION		ALTERNATIVE WITH EMP		ALTERNATIVE WITHOUT EMP		DESCRIPTION OF QUALIFICATION
	CA	AA	CA	AA	CA	AA	
FAUNA	-1.8	Low	1.0	Low	-4.8	Medium	At present time the Alteration is also low on fauna, but the lack of implementation of the measures in the EMP will make the affectation more critical, reaching a rating of medium. Implementation of the EMP will generate a benefic change in this component, maintaining a low environmental affectation and permitting the project to develop in harmony with the environment.

Table 11. Summary Assessment of Identified Interaction for Implementation of EMP of Socioeconomic Resources – Multipurpose Anamichú Project (Department of Tolima)

	PRESENT CONDITION		ALTERNATIVE WITH EMP		ALTERNATIVE WITHOUT EMP		DESCRIPTION OF QUALIFICATION
	CA	AA	CA	AA	CA	AA	
SOCIO ECONOMIC	3.0	Low	7.0	Medium High	-1.4	Low	The original concept of the productive project has the objective of improving the quality of life of a marginal social group from the state agrarian politics, which has opted for surviving from illicit activities. The influence of the project in the socioeconomic element is therefore beneficial. The parallel development of the EPM will bring added benefits both to the socioeconomic element and to the environment. Not applying the measures of the EMP will reflect in the exhaustion of resources an thus on the sustainability of the project in time and the survival of the community. Additionally, it is probable that the affectation will extend to the buffer zone of the Natural Park of Las Hermosas, a reason for which the EMP includes measures that permit the cooperation of the community in the conservation and care of this area.

3.3 METHOD FOR CALCULATION QUANTIFICATION OF IMPACTS

The addition of equation (1), applied to the impacts of Air Pollution due to cleaning of the land, Application of Agrochemicals and other activities, (1), Landslides in Sloping Areas, (8) and Formation and Technical Assistance, (27), due project activities are exemplified in the following table :

Table 12. Example of Quantification of Identified Impacts

IDENTIFIED IMPACTS		PROJEC WITH EMP								PROJEC WITHOUT EMP								ENVIRONMENTAL QUALIFICATION EC	
		INCIDENCE			DURATION			SCOPE		INCIDENCE			DURATION			SCOPE		WITH EMP	WITHOUT EMP
		3.0	2.0	1.0	0.5	1.0	1.5	0.4	0.6	3.0	2.0	1.0	0.5	1.0	1.5	0.4	0.6		
Air Pollution due to cleaning of the land, Application of Agrochemicals and other activities (1)	1			**1.0**	**0.5**			**0.4**				**-1.0**		**-1.0**		**-0.4**		**1.9**	**-2.4**
Landslides in Sloping Areas (2)	8		2.0				1.5	0.4			-2.0				-1.5	-0.4		3.9	-3.9
Formation and Technical Assistance (3)	27		2.0				1.5	0.4		-3.0					-1.5	-0.4		3.9	-4.9

3.4 FINAL RESULTS

The summary of the assessment is as follows:

Table 13. Summary of Environmental Alternatives' Assessments

AFFECTED ENVIRONMENTAL RESOURCE	PRESENT CONDITION	ALTERNATIVE WITH EMP	ALTERNATIVE WITHOUT EMP
AIR	-1.2	1.5	-4.3
WATER	-3.2	0.3	-7.0
SOIL	-3.4	0.1	-7.1
FLORA	-2.2	0.8	-5.4
FAUNA	-1.8	1.0	-4.8
SOCIOECONOMIC	3.0	7.0	-1.4

According to the previous table, the environmental resource that is most affected by the actions of the project, without the EMP measures, is soil, (-7.1), and even with the measures in place the resource is not totally recuperated, particularly considering the impacts generated by scouring along gullies and poor drainages near the farming lands. The resource that could follow in alteration is water, due to deterioration of water quality from potential drainage alterations and use of pesticides (-7.0); flora has a total affectation of (–5.4), mostly due to the disappearance of valuable species if the deforestation continues, the farming of illicit crops remains and the intense use of pesticides is continued.

Impacts produced on the social realm, in case the measures of the EMP are not carried out, could have an adverse effect, due mostly to the lack of a monitoring and follow up system, albeit of low impact, since the project seeks to mitigate a social problem with the substitution of illicit cultivation through an agricultural activity that allows for the subsistence of the community and an improvement of the living conditions, an objective that can easily been reached even without the implementation of an EMP.

It is evident, however, that the benefits of implementing an EMP are the greatest, (7.0), since they are the key to the sustainability of the natural resources and therefore base for their continued, sustainable use towards the future.

SECTION 4 AFFECTED ENVIRONMENT

4.1 PROJECT DESCRIPTION

4.1.1 General

The project "Regional Proposal for the Eradication of Illicit Crops by Way of the Implementation of an Agrosilvopastural System in the Canyon of the Anamichu River", contemplates production in various different types of soil and climate, found in the canyon of the Anamichu river. Two predominant ecosystems in the canyon, based on the so called zones of life, are:

- Humid Premontainous Forest zones (Bh-pm), between 1,700 mosl (meters over sea level) and 2,000 mosl, are designated for eradication of 2.5 ha of poppy crops, per each agricultural unit (family), to be substituted with 1 ha of organic coffee, 1 ha of high-grade coffee and walnut, and 0.5 has for various food-crops that will generate additional food supply and income in the short and medium term, such as beans, peas, vegetables, chickens, tall grass and two calves.

- Low Mountainous Forest (Bh-pm) located between 2,000 mosl and 2,500 mosl, also designated for the eradication of 2.5 ha of poppy, per agricultural unit, with 1 ha of "credo" o Romeron pine, and 1.5 ha divided in two crops including tall grass, garlic, "Achira", chickens, vegetables and two calves.

4.1.2 Location

The project "Regional Proposal for the Eradication of Illicit Crops by way of Implementing an Agrosilvopastural System in the Canyon of the Anamichú River" is located in the southwest of the Department of Tolima, in the Municipality of Rioblanco, *veredas* (or rural divisions) of Alfonso Carrillo, La Catalina, La Playa, La Albania, Yarumales and La Legía.

To arrive at the project area, one starts at the urban township of the Municipality of Rioblanco, heading towards Gaitán, which is approximately 33 km away along an unpaved, relatively fair road. From there, one follows the horse trail along the left margin of the Anamichú river to arrive at the *vereda* La Playa, after 8 to 10 hours on horseback.

4.1.3. Crop Types

The project includes developing 300 ha of various crops, using an agrosilvopastural system approach, as follows :

- Organic – Coffee + timber 60 ha
- Silvopastural Cedar - Romeron Pine System, 60 ha
- Tall Grass (for cattle rising) 60 ha
- Beans, garlic, corn, "Achira" and pea crops 60 ha
- Coffee + Walnut , 60 ha

4.1.4 Agricultural Management

The seedling nurseries must be installed in January so the plants can be transported to the final site in September, the best time of year to plant in the southern part of Tolima. Coffee plots must be outlined according to the inclination of the slopes, following level contours,. Corn, peas, "achira", garlic, vegetables and bean crops should be planted in areas as flat as possible. Removal of weeds is also recommended.

The planting season correspond to the second semester, coinciding with the rainy season, at the end of September and beginning of October; however, transition crops may be planted at during any time of year. The sowing techniques recommended for peas, (*Pisum sativum*) and beans (*Phaceolus vulgaris*) are simple shoulder type; for garlic (*Allium sativum*), the sowing is in multiple lines generally 1.2 to 1.5 m wide, 15 cm high, with a 42 cm ditch for separation.

For the "Achira" planting (*Canna edulis*), the best time of year is at the beginning of the rainy season during the months of September and October, using separation of 0.8 m between plants and 1 m between mounds.

Since the Agrosilvopastural system has been designed towards organic agriculture, it is recommended the use of non-contaminating raw materials and ecological inputs to obtain low environmental impacts, to obtain crop sustainability. Recommended organic products include: Plagafin, Agrisan, Hidrolato de manzanilla, Hidrolato de caléndula, Pestibol, Hidrolato de Ortiga, Hidrolato de Ajenjo, Hidrolato de Higuerilla, Hidrolato de Ajo, Ají, Hidrolato de Tabaco; and organic fertilizers such as: Nutrimins, Fertilimor, Nutricosecha, Nutrifol 10-30-10, (Ca, Mg, Zn, Bo - foliar), Nutrihumus Agrisan, chicken manure, coffee pulp and night crawlers humus. The pesticide analysis presented below, includes a detailed presentation of toxicity of chemicals, plus an Integrated Pest Management (IPM) control practice that allows for small or no use of agrochemicals.

Post-harvest activities in coffee farming include:

- Selection of coffee post-harvest: Only ripened beans may be collected to yield higher income, best quality "*pergamino dry*" coffee. This will also reduce infestations by "*broca*" an endemic coffee blight, that could make up for as much as 10% loss in crop yield.
- Transportation of coffee beans to processing sites: In sloping terrain, beans are transported thru cement or wood channels down-slope, or in covered tin containers.
- Pulp separation: Must be done in dry conditions.
- Bean grade classification : Sieve classifiers must be used.
- Bean fermentation: use mechanical systems or fermentation tanks to decompose the mucilage that covers the coffee bean, dissolving it in water and disposed by washing. This process takes between 18 to 30 hours, depending on weather
- Bean washing: use with clean water and recycle to reduce the costs.
- Drying: Can be done naturally or artificially. Solar energy is the most common, and cheapest, system to dry coffee beans, utilizing drying carts or terraces to expose the grain to sun and the wind. Artificial drying is done in special electrical or fuel oil-powered driers.

For other crops (beans, peas, corn, garlic), the harvest and post harvest activities are limited to selection and packaging of products, which requires no special handling. The sub-products (mostly pulp), must be transported (and dehydrated if possible) to storage sites or decomposition sites, these may be a pond, or cement box, or to worm compost beds. Recycled pulp and compost is for fertilization of seedlings, or applied to crops as nutritional complement, or to improve soil conditions. Solid waste from leaves and stems leftovers after harvesting beans, peas, corn and garlic crops. This organic material is used to fertilize and improve physical condition of soils.

Liquid waste represented mostly by mucilage leftovers and water used during the coffee process, can be recycled to be used as crop fertilizer; mucilage can be added to enrich pulp, or taken to worm nurseries, and in some cases, it can be used as pet and domestic animal feed.

Liquid waste represented mostly by mucilage leftovers and water used during the coffee process, can be recycled to be used as crop fertilizer; mucilage can be added to enrich pulp, or taken to worm nurseries, and in some cases, it can be used as pet and domestic animal feed.

4.1.5 Cattle Management

The use of pastures for cattle growing is not recommended. Farmers are advised to adopt stock confinement stabled systems. In small areas, the use of stable systems can be implemented through cultivation of tall grass. Another animal feed is the foliage of the "*achira*" plant, which has produced good quality for animal consumption.

Chickens and domestic fowl farming can also be done in sheds or corrals to facilitate bird's handling. Fowl feed must be placed in feeders, along with water containers. Barn, corral or shed floors should be designed to facilitate cleaning, and eliminate odors thus reducing the risk of infections.

4.1.6 Organization

The project was officially registered at PNDA by Agreement 33/01 of the National Plan for Alternative Development – PNDA and contract N° PA – 52, under Act of Intention of the Social Pact for Voluntary Eradication of Illicit Crops, signed in the town of Gaitán, (Rioblanco), on February 9, 2001, by PNDA, the National Coffee Growers Federation of Colombia, the Tolima Department's Committee of Coffee Growers, the representatives of the departmental and municipal governments and the residents of the canyon of the Anamichú River.

The actors that take part in the structuring of the project are:

Chemonics: in charge of administration of financial resources supplied by USAID in support of programs carried out by the Colombian Government through the National Plan for Alternative Development – PNDA. Chemonics granted funds to The National Federation of Coffee Growers, acting as project trust administrator, and in turn the Federation delivers the resources to its departmental committee, in charge of project's operations.

PNDA: acts as project supervisor, in coordination with Chemonics.

The Tolima Committee of Coffee Growers: acts as the project local operating agent, in charge of administration of resources, coordinating project activities and development, and monitoring.. The Committee provides producers with technology transfers and technical assistance through its staff of four professionals and two technicians.

Project beneficiaries: the small farmers living in the Anamichú canyon, organized in Communal Action Boards and associations of producers, like the Rioblanco Beans Producers Association.

4.1.7 Demand for Natural Resources

The greatest demands for water do not come from crops themselves, but instead from post-harvesting processes, especially coffee bean processing.

In planting beans and peas, the stakes required last three years, 1,670 stakes are required per hectare. This imposes a potential threat to trees as well as to the natural environment.

Coffee requires isolated areas for storage and control of pulp. There must also be separate areas to pile organic material originating in corrals and sheds.

Coffee develops well in loose soil, rich in organic material, with an effective depth of more than 50cm and an organic horizon greater than or equal to 20cm; pH must be between 4.8

and 6.0. Productive crops such as peas, beans, garlic, corn or "achira", do not require more water than coffee. Note also that any planting in slopes of 50% or more is unadvisable because it will increase the risk of erosion and/or landslides.

"Achira" can be farmed on any type of soil, the optimum are soils of homogenous textures, good draining, rich in organic material, with a pH between 5.0 and 7.0.

4.2 ENVIRONMENTAL DESCRIPTION

4.2.1 Project Location

The multipurpose farming project of Anamichú, (Agrosilvopastural project), is located in the south west portion of the Department of Tolima, in the municipality of Rioblanco, *veredas* Alfonso Carrillo, La Catalina, La Playa, La Albania, Yarumales and La Legía.

4.2.2 Definition of the Project Area of Influence

The project's geographical baseline allows for assessing and correlating environmental effects that the project may cause in the direct area of influence and in the indirect regional area of influence. On this basis, the methodology chosen for Assessment of Environmental Alternatives is described below.

4.2.3 Indirect Impacts - Regional Area of Influence

This area corresponds to zones near the project, that are not influenced directly by project activities or receive pressures natural resources. Geographically, it comprises the municipality of Rioblanco, plus the area of the Natural Park Las Hermosas, the latter may be subject to potential impacts by association.

4.2.4 Direct Impacts – Focalized Area of Influence

This area is subject to direct intervention of physical, biotic and socioeconomic project environmental components. This area comprises the *veredas* Alfonso Carrillo, La Catalina, La Playa, La Albania, Yarumales and La Legía.

The Environmental Management Plan will focus prevention, mitigation and correction measures on the project direct area of influence.

4.2.5 Physical Component

The Anamichú river originates at the Natural National Park of Las Hermosas, there are no significant activities in that zone, other than small-scale agriculture, cattle growing at the family subsistence scale, and illicit poppy crops.

The quality of the water of the Anamichú river was analyzed, samples were collected at the intersection of the road that goes from Rioblanco to the town of Gaitán. The results are presented in the following table.

Table 14. Results of Water Quality Laboratory Tests, Anamichú River

Quality Parameter (units of measure)	Anamichú River at Gaitán	Colombian Standards
QOD (mg O_2 /L)	1,0	
pH (Units)	7,74	6,5 – 8,5 *
Total Solids (mg /L)	66	Does not apply
Hardness (mg $CaCO_3$ /L)	39,84	Does not apply
Sulfates (mg SO_4 /L)	10,3	> 400 *
Chlorides (mg Cl/L)	0,2	> 250 *
Nitrogen (Ammonia) (mg NH_4 -N /L)	0,13	1,0 *
Nitrate (mg NO_3 -N /L)	0,11	10,0 *
Nitrite (mg NO_2 -N /L)	< 0,006	1,0 *
Orthophosphates (mg P /L)	0,019	Does not apply
Phosphates (mg P /L)	0,018	Does not apply
Organichlorinated Pesticides (µg /L)	<0.2	-

Source : Decree 1594/84 *Articles 38 and 39

The results of the Anamichú river water testing are basic reference data for water control at points beyond the project area. The tests indicates the excellent physico-chemical quality of the water. When compared to the national standards found in Decree 1594/84, the results found are very acceptable, far above the quality limits set by the Colombian Government standards. Note that Colombian water quality standards are stricter than standards in Europe, WHO or the U.S., (USPHS – USEPA). Reference parameters in future testing are indicated below.

- Dissolved oxygen, every 2 hours for 24 hours every 6 months.
- Compound sample of DBO 6 hours old.
- Compound sample of DQO 6 hours old.
- Sample and analysis of Benthic organisms, (biotic indicators).
- Sample and analysis of Perifiton organisms, (biotic indicators)

These tests need to be done every six months as part of the environmental checklist, unless there is reason to believe there is some kind of contamination or spilling affecting the Anamichú river, more frequent samplings should take place if this is the case.

4.3 BIOTIC COMPONENT

The following is a the biotic characterization of the direct area of influence of the project. Endangered species and strategic ecosystems, such as the National Natural Park of Las Hermosas, are referral points.

The Project area belongs to the sub Andean forest system, a humid isothermal forest, with temperatures ranging from 14 ºC to 24 ºC; it is also classified as tropical forest and humid, very humid and rainy Pre-montainous and low-mountainous thermal floors.

The structural characteristics of the forest represent a complex composition of species of trees, bushes, palms, shrubs and herbs; most of the tree species in the region are valuable woods. To day, this forest is subject to severe anthropic pressures due to widespread deforestation for cultivation of illicit crops like poppy, at the 2,500 m level.

The sub Andean forest biota maintains close relationship with low-land zonal biomass, both have many species in common while others originated in warm humid forests. There is no center of endemism located near the area of the Anamichú project.

The structural characteristics of the forest represent a complex composition of species of trees, bushes, palms, shrubs and herbs; most of the tree species in the region are valuable woods. To day, this forest is subject to severe anthropic pressures due to widespread deforestation for cultivation of illicit crops like poppy, at the 2,500 m level.

The typical Colombian Andean forest is formed by several strata, with about 31 families and 64 species of trees; in the bushes strata, there are up to 12 families and 37 species, in the pasture lands, there are 13 families y 44 species, and in the shrubs there are some 11 families and 24 species; there are also 5 species of palms within two families.

The size of animal groups is directly related to the density of the forest mass in the area; thus, larger densities and lower anthropic influence, means greater biodiversity and greater stability of the animal population and its structure, especially for middle and large-size mammals, which are the most affected at these altitude levels.

In the Anamichú canyon, intervention of the forest has been produced in patches where fauna has lost habitats; however, in some sectors in the highest points of the canyon, it is possible to see patches of vegetation which serve as refuge and above all as escape corridors for animals comong down from the Páramo of Las Hermosas in search of food.

The Anamichú project is located in the canyon of the Anamichú river between 1.500 and The project zone is located in the Anamichú river canyon between 1,500 and 2,500 mosl, bordering with the *páramo* highlands at 3,000 mosl. This characteristic, and specially the fact that the zone is an area of exclusion not delimitated clearly, generates some problems particularly in the incorporation of cattle to the project (395 heads) that could affect the 500 m buffer zone, located, theoretically, between 2,500 and 3,000 mosl).

4.4 SOCIAL ASPECTS

4.4.1 Social and Cultural Results of Poppy Production

The 120 families that joined the voluntary illicit crop substitution program are residents of the six *veredas* of the project, and traditional farmer families living in the project area. The need to increase family incomes and improve living conditions prompted these families to plant poppy in the first place, no other alternatives were available. Social problems like fathers abandoning homes, children and women becoming uncared for, male dominance and disregard for family economic support, rampart drinking, prostitution, gambling, wife and children abuse constitute part of the poppy culture. Few families could save money, or invest for that matters.

Housing construction is characterized by predominant "*bahareque*" or waddle walls, pressed mud is a common building material, along with cement floors and galvanized roofing. This problem becomes critical if more than one family inhabits the house.

4.4.2 Institutional Intervention

The Colombian Government's institutional efforts to remedy the social situation described above were unsuccessful because they lacked the necessary credibility to initiate the right processes. The Coffee Growers Committee of Tolima offered a different approach as they did have recognition in the farming community, especially those in the coffee business; the view in the community was that it was a serious entity that was committed to helping them.

The Committee's experience in substitution programs include search for alternative crops for coffee growers, in general, which enabled them to offer a plan that had the backing of professional personnel.

The work *vereda* by *vereda* to conform nuclei, permits the coordination of the process and also social control over the execution of the agreements. The permanent support with social workers resulted in social identification of the specific needs to be supported by technical processes, while providing information on the socioeconomic, cultural and environmental relations. The presence of the Committee in the area was the first institutional participation with any real positive effect. This continues to date and is part of the overall Chemonics plan in the region.

4.5 CONCLUSIONS

The altitudinal fringe where the Anamichú project is to take place, is an area that has been floristically altered for many years, as can be seen in aerial photographs of the *veredas* that make up the project. However, the proximity of the project to the National Park of Las Hermosas means that the project must guarantee that Agrosilvopastural activities will not

generate any further biological deterioration to the Hermosas Park, under GOC environmental protection.

At the moment there is no clear definition of the buffer zone around the park, which is vital to establish incompatibilities between the project and the Las Hermosas Park, this aspect becomes more important since the altitudinal fringe between the limit of the project and the lower limit of the park is only 500 m.

The flora and fauna of Las Hermosas is in good condition, while wildlife habitats in the project zone are highly deteriorated as result of massive deforestation to make room for planting illicit crops. Floral species recommended for coffee shade and for reforestation of areas intervened, are endemic to the region and found in natural environmental state throughout the Anamichú canyon.

4.6 RECOMMENDATIONS

As a result of the diagnosis of the biota, it was determined that the Anamichú project had to establish some restrictions to avoid future problems with the National Natural Park Las Hermosas.

The free open bovine grazing must be avoided, because it causes erosion and serious soil stability problems in the area, especially in zones with slopes over 80%.

The felling of trees for lumber must also be avoided, especially in the buffer zone and between the project and the park, applying conservation programs and development of tree nursery as integral strategy to prevent tree loss, added to community awareness and training, become.

Integrated pest management programs must be put into effect, as well as the use of biological products for the elimination of Pest. A full PERSUAP analysis is presented below, where each potentially used agrochemical is examined for its toxicity, ecotoxicity and compared to non-chemical options. Due to the difficult accessibility to the project, chemicals have not been part of the established culture of the area, hence this helps in diminishing the possibility of affectation of the surrounding environment by agrochemicals.

Promote the teaching of an environmentally sustainable agricultural production in order to protect the vulnerable ecosystem neighboring the project.

4.7 PESTS AND PESTICIDE PROBLEMS IN CROPS IN THE ANAMICHÚ PROJECT

Crops in the Anamichú project pose several challenges regarding management of crop pests and pesticides used to control them, which could likewise pose environmental risks that need to be dealt with.

The following section presents a summary of pests affecting crops in the Anamichú project and their management, including toxic and eco-toxic analyses for pesticides used by farmers, as well as existing options for an Integrated Pest Management (IPM) program that will allow for continuous decrease in use of agrochemicals[4].

4.8 IMPORTANT FINDINGS AND GENERAL RECOMMENDATIONS

4.8.1 The Colombia Alternative Development (CAD) Program

The Colombia Alternative Development (CAD) program, funded by USAID in the context of the larger Plan Colombia, supports farmers, farmers' families and farming communities that have been so far involved in the production of illicit crops, such as coca and poppy, to voluntarily switch to licit crop production. Working with communities, community associations, and municipalities in the departments of Bolivar, Cauca, Caqueta, Huila, Nariño, Norte de Santander, Putumayo, and Tolima, the program is creating licit economic opportunities that generate income, improve the quality of life, protect the environment, and support ethnic and cultural values for peaceful coexistence. The program uses an open-bid approach to call for proposals from farmers' organizations and supporting basic staple crops ('*cultivos de pan cojer*') as well as 'industrial' crops targeted to internal or external markets, many of them with associated industrial processing and transformation.

So far, most crops supported by CAD have been low-input agricultural systems, ecologically appropriate, with an integrated, if not an ecological or organic, approach to crop production and pest management (see "Pest of crops in the Anamichú Project and Management Guide" in tables below). This is the type of alternative development seeks to protect the health of project beneficiaries and the environment in project zones, as well as maximizing sustainability in the long term by diversifying production systems, reducing production costs and marketing.

[4] The detailed requisites for pesticides in Reg. 216.3.(a).10.(b).(1).(i).(a) – (l), being literals (a) through (l) will be presented as numerals 1 to 4.2 plus the subsequent explanatory tables 1 through 8.

<u>Recommendation No. 1</u>: CAD should continue with this eco- friendly approach to promote alternative crops, leading into sustainable development, to the benefit of the Colombian environment and the health of participant farmers and their families, as well as of the consumers.

4.8.2 Insect Pest Infestation and Diseases

CAD is actually taking crops from traditional cropping areas to new ones in the Colombian territory. Although, the majority of these crops are not really foreign, to the country or to the regions where CAD is operating, they have been grown, if at all, only in very reduced areas.

<u>Recommendation No. 2:</u> In order to prevent the dissemination of contaminated crop seed with pathogens, insect pests, and weed propagators. CAD should establish a strict plant sanitation-quarantine system based on international agreed and Instituto Colombiano Agropecuario (ICA) certification procedures and quarantines for the movement of plant materials into the country as well as from one region to another within Colombia.

4.8.3 Pesticide Assessment

The review of pesticides presently used by farmers, recommended by technical institutions and/or so far requested by project operators for their productive activities (can be seen below in the tables that follow). Most of these pesticides were cleared based on the review of the 12 points of *22 CFR 216.3(b)(1)*. However, some of them do not fully comply with USAID environmental requirements for development projects. Of the total, only 16 active ingredients were selected, to be further studied as possible pesticides to be used in crop pest management (see tables No. 20-23). These pesticides were then subjected to the more complete 'risk analyses, discussed and shown in a table No. 26.

<u>Recommendation No. 4</u>: Some of the pesticides being presently requested and or purchased by CAD operators are to be *phased out* following the subsequent timeline. (a) In order to allow time for the search of alternative products, preferably non-chemical, while still protecting the crops, the insecticides: carbofuran, chlorpyrifos, and profenofos, and the fungicides: chlorothalonil and copper oxychloride should be phased out in the medium term (1-1.5 years). (b) Due to higher than accepted health and environmental risks, and the availability of pest management alternatives to these molecules, the fungicides: benzimidazole, captafol, hexaconazole, kasugamicine and ofurace, and the insecticides: methomyl, cyfluthrin, cyalothrine (lambda) and cypermethrine should be phased out in the short term (0.5-1 year). (c) The highly toxic and easily replaceable insecticides: monocrotophos, metamidophos, aldicarb, isazophos, and methyl parathion and the herbicide: paraquat should be phase out immediately. (d) And finally, and additionally to this, no product listed in the prohibited

pesticides category in the US or Colombia, should ever be used in this project (see section 5.1.4).

4.8.4 Safer Use Practices

Colombia is one of the most advanced countries in Latin America in regards to pesticide registration, regulation and control, as well as in agronomy and associated disciplines. Colombia has adopted state of the art pesticide registration procedures, including international standards and codes for pesticide labeling and a follow-up system to control pesticide manufacturing and distribution, albeit limited by security issues during the past 25 years. Most technicians working in Colombia in pest and pesticide management have solid knowledge and understanding of IPM and safer use of pesticide procedures. However, there is room for improving interventions on Safer Use of Pesticides (SUP). The majority of farmers participating in CAD projects do not use the 'best practices' approach in dealing with SUP: less than 10% use some type of personal body protection in handling and product applications, and 70% of those directly exposed to pesticide spills do nothing, not even cleaning up or decontamination procedures (US Embassy, 2001).

Recommendation No. 5: Considering the traditional attitudes and practices of participant farmers regarding use of pesticides, as well as the limited GOC official presence in isolated, and conflictive, areas where CAD is operating, it is recommended that a strong SUP program be implemented. Such program should (a) be based on the pre-existing training offer already available in Colombia; (b) attempt to raise 'awareness' of health and environmental pesticide hazards, as well as to teach 'good practices' on SUP; and (c) include parallel training in 'ecological agriculture' and IPM, to prevent SUP to become a false panacea.

4.8.5 Pest Management Approaches

Most Colombian professional agronomists have been exposed to, trained in and has an understanding, if not a full knowledge of IPM. This has become, not only the 'official' approach to pest management at the state-government institutional level (ICA), but also it has taken root in para-statal (Corpoica) institutions, in charge of pest and pesticide R&D, as well as in private R&D organizations. This is the case of grower associations, such as Cenipalma, Cenicafé, Cenicaña, and Fedecacao. Moreover, Colombia is the headquarters for the well reputed CIAT, a centre for tropical agricultural research that has conducted pioneer research on IPM of insect pests and diseases in various crops, foremost among them cassava. Relevant to this PERSUAP, we highlight the availability of IPM programs for oil palm, cacao, plantain, sugar-cane, rice, and timber plantations.

As shown in the tables below, Colombia is well advanced in the production of bio-inputs for pest management, such as microbial pesticides, entomopathogen fungi, bacteria and viruses, as well as nematodes and parasitic wasps. These bio-inputs are produced and sold in the country by a variety

of small, mainly national, industries (see tables below). The important issue, from an IPM perspective, is that these products become a readily available, much healthy an environmentally friendly option to the chemical pesticides. As per an expert entomologist and IPM practitioner, "Colombia is better positioned than the US for the supply of bio-pesticides to agriculture".[5]

<u>Recommendation No. 6:</u> CAD is encouraged to disseminate, among project operators, both of the below lists of bio-pesticides (Table 1) and enterprises producing bio-products (Table 2) in an effort to promote their use in substitution of the more toxic and environmentally hazardous chemical pesticides.

As per a Reg 216 requirement, and as stated previously, in order not to transmit the false idea that pesticides, used safely, could be the sole solution to pest problems, SUP should not be promoted in isolation but rather in the context of a larger, more comprehensive approach to pest management, that of Integrated Pest Management, or IPM. Colombia is well ahead in IPM research and development as well as in IPM training. Additionally to the pesticide analysis, a considerable amount of effort in the preparation of this PERSUAP has been allocated to the development of IPM matrices that summarize the available tactics to manage the major crops pests and provide the user with additional references to the subject as well as main contacts for technical support and their Management in this section. This is to the benefit of the CAD project operators that can find in these tables guidance for the avoidance of the most toxic pesticides as well as non-chemical options for pest management.

<u>Recommendation No. 7</u>: In spite of the good technical level of the field technicians working within CAD and the CAD project operators, technical support in IPM should be strengthened. This may take the form of (a) crop specific field demonstrations on the use of non-chemical pest control methods; and (b) provision of support to the technical staff of the operators for training-of-trainers as well as for direct farmers training in crop-specific IPM programs.

[5] Dr. Anthony Bellotti, Cassava IPM Leader, CIAT, personal communication.

Table 15. Main Biological Inputs Produced in Colombia

Entomo-pathogen Fungi	Fungi Bio-fungicides	Parasitoids	Predators	Entomopatho-gen Bacteria	Entomopatho-gen Viruses
Beauveria bassiana	*Trichoderma harzianum*	*Trichogramma exigumm*	*Chrysoperla externa*	*Bacillus thuringiensis*	Nuclear Polyhydrosis Virus (NPV)
Metarhizium anisopliae	*T. lignorum*	*T. pretiosum*	-	-	*Baculovirus ello*
Paecilomyces fumosoroseus	*T. viridae*	*T. atopovirilia*	-	-	-
Nomuraea rilely	*Gliocadium spp.*	-	-	-	-
Paecilomyces lilacinus, minense	-	-	-	-	-
Verticillium lecanii	-	-	-	-	-

* Table courtesy of Dr. A. Bellotti, CIAT.

Table 16. Main Enterprises producing Biological Inputs in Colombia

Enterprise	Inputs = Organisms
Agricultura Biológica (Buga-Valle del Cauca)	Entomopathogen fungi, Parasitoids, Predators, Bio-fungicides
Agrobiol (Buga-Valle del Cauca)	Parasitoids
Bioecológicos (Palmira-Valle del Cauca)	Entomopathogen fungi, Parasitoids, Predators, Bio-fertilisers
Biocontrol (Palmira-Valle del Cauca)	Entomopathogen fungi
Productos Biológicos Perkins (Palmira-Valle del Cauca)	Entomopathogen fungi, Parasitoids, Predators
Productos Biológicos El Bolo (Palmira-Valle del Cauca)	Parasitoids
Laverlam (Cali-Valle del Cauca)	Entomopathogen fungi and viruses
Orius (Villavicencio-Meta)	Entomopathogen fungi
Biogarden (Bogotá-Cundinamarca)	Entomopathogen fungi
Biocaribe (Medellín-Antioquía)	Entomopathogen fungi
Live System Technology-LST (Bogotá-Cundinamarca)	Entomopathogen fungi, Bio-fungicides

* *Table courtesy of Dr. A. Bellotti, CIAT*

4.9 PERSUAP, BACKGROUND

4.9.1 CAD Environmental Compliance

CAD is undertaking full compliance of USAID environmental regulations in Colombia. Previous Initial Environmental Examinations (IEE) have been completed for most CAD projects and related activities, as per LAC-IEE-99-38 and LAC-IEE-00-35. A Programmatic Environmental Assessment (PEA) was completed for CAD and approved in June 2003. USAID required CAD to regularize environmental compliance, including preparation of a full study on pesticides used in alternative crops promoted by CAD. To this effect, Chemonics International commissioned the present Pesticide Assessment Report and Safer Use Action Plan (PERSUAP) for crop projects supported by CAD to date.

4.9.2 PERSUAP

This PERSUAP has been prepared to achieve the dual purpose of (a) complying with USAID environmental regulations, and (b) providing CAD project operators with practical tools for better and safer management of pests affecting their crops. The PERSUAP not only analyses pest and pesticide issues in crops supported by CAD, but also addresses broader issues related to pest and pesticide management in CAD and in Colombia, such as GOC regulatory and institutional frameworks, agro-ecology of areas of intervention, training and technical capacity strengthening, and provides guidelines for SUP and IPM, as well as identifying project opportunities in Colombia. Future commodities, pests and pesticide products to be considered under CAD, are covered in this document.

During preparation of the PERSUAP, visits were made to the Instituto Colombiano Agropecuario (ICA), the Colombian pesticide authority, and to major Colombian and international technical institutions offering pest management technology and training, such as Cenipalma, Fedecacao, IICA, Corpoica, Centro de Excelencia en Fitoprotección (Aphis, USDA, IICA, ICA, USAID), CONIF; universities (Nacional) and training centers (SENA); private sector (Bayer CropScience, ANDI, BioEcológicos, SEG, pesticide dealers); and environmental consultant companies (Tres Elementos, CAEMA). The consultant traveled to Norte de Santander (Cúcuta) and Putumayo (Puerto Asís), to meet CAD project operators, technical staff and conduct project observations on-site.

4.10 PESTICIDE ASSESSMENT REPORT AND SAFER USE ACTION PLAN ANALYSIS

4.10.1 Pesticide registration statuses in Colombia and with US-EPA: 22 CFR 216.3 (b)(1)(i)(a)

Close to 55 pesticide active ingredients were screened for their registration status with the Colombian authority, the Instituto Colombiano Agropecuario (ICA)[6], and with US Environmental Protection Agency (USEPA)[7] This list of pesticides was compiled from that sent by CAD operators to Chemonics requesting purchase clearance, in June 2003, and other pesticides following the recommendations of Colombian state and private technical institutions[8].

<u>Recommendation No. 8</u>: The list of pesticides to be purchased by CAD operators should be screened by the CAD Natural Resources and Environment (NRE) team, based on the pesticide lists included in this PERSUAP. Pesticides not mentioned in this PERSUAP should be subjected to a screening process. Products not registered with Colombia-ICA and with US-EPA should not, in principle, be approved (see exceptions discussed below).

<u>Recommendation No. 9:</u> The summary of the pesticide analysis with the associated recommendation is:

- **<u>Products not registered in the US and Colombia or in PIC[9] list</u>. NOT TO BE USED UNDER ANY CIRCUMSTANCE: captafol, isazofol, methyl parathion and methamidophos.**
- **<u>Products not yet registered in the US or Colombia</u>. Although a microbial product, the first, and a plant extract, the second, they are NOT TO BE USED UNTIL REGISTERED in at least Colombia: *Baculovirus spodopterae* and *Swingla* (extracts).**
- **<u>Products not registered in Colombia.</u> NOT TO BE USED UNDER ANY CIRCUMSTANCE: endosulfan.**
- **<u>Products not registered with USEPA</u>. NOT TO BE USED UNDER ANY CIRCUMSTANCE: benzimidazole, hexaconazole, kasugamicine, monocrotophos, and ofurace.**
- **<u>Products not registered w/USEPA.</u> But registered in Colombia. APPROVED TO BE USED: extracts of *Glyricidia sepium*, because the resource (*Glyricidia*), the crop (vanilla) and the pest (*Cylsia*), are not present in the US; *Paecilomices liacinus*, because the crop (heart of palm) and the pest (*Leptopharsa*) are not present in the US and the**

[6] For this, an updated "Chemical Pesticide, Bio-inputs and Generics" database was obtained courtesy of ICA authorities.

[7] For this, EPA databases were consulted at its web site.

[8] Sources for technical information were the official ICA or Corpoica, Colombia government recommendations, the growers associations or research centres, international research centres and literature references applicable to Colombian conditions, with solid technical and scientific background.

[9] 'PIC List' is the Prior Informed Consent List of the Rotterdam Convention, led by UNEP and FAO, that applies to the international shipment of the most hazardous chemicals.

pesticide is a microbial insecticide with unlikely environmental or health impact; and *Trichogramma pretiosum* and *Verticillium lecanii*, are both microbial insecticides with unlikely environmental or health impact.

- **<u>Products are RUP with USEPA.</u> NOT TO BE USED: aldicarb, cyalothrine (lambda) cyfluthrin, chlorothalonil, chlorpyrifos, copper oxychloride, cypermethrine, methomyl, paraquat, profenofos**
- **<u>Products are RUP[10] with USEPA.</u> USE ONLY CERTAIN FORMULATIONS to reduce health or environmental risk: carbofuran (pellets/tablet), and picloram (Tordon 101R).**

The timframe for the implementation of these recommendations is given in Table below

Table 17. Summary of Pesticides to be Phased Out of CAD

To be phased out immediately:			To be phased out in 6-12 months		
Technical Name	**Trade Name**	**Uses**	**Technical Name**	**Trade Name**	**Uses**
Monocrotophos	Azodrin	Heart of palm	Benzimidazole	Benomyl+	Requested by operators
Methamidophos	Tamaron	Various crops	Captafol	Difolatan	Cassava
Aldicarb	Temik	Potato	Cyfluthrin	Bulldock	Requested by operators
Isazofos	Miral	Potato	Hexaconazole	Anvil	Requested by operators
Methyl-parathion	Methyl-parathion, etc.	Rice	Methomyl	Lannate	Requested by operators
Paraquat	Gramoxone	Various crops	Kasugamicine	Kasumin	Potato

To be phased out in 12-18 months			To be phased out in 6-12 months		
Technical Name	**Trade Name**	**Uses**	**Technical Name**	**Trade Name**	**Uses**
Carbofuran	Furadan	Cassava,Rubber, Plantain, Nurseries	Ofurace	Grolan	Requested by operators
Copper oxychloride	Agrotox	Cassava	Cyalothrine, lambda	Karate, Terminex	Potato
Chlorpyrifos	Lorsban	Plantain, Oil Palm, Cassava, Rubber, Forest Plantations	Cypermethrine	Saat Pop, Agroper, Cipermetrina	Rice
Profenofos	Curacron	Rubber	----------	----------	----------
Chlorothalonil	Bravo	Rubber	----------	----------	----------

[10] RUP: Restricted Use Pesticide.

4.10.2 ASIS FOR SELECTION OF PESTICIDES: 22 CFR 216.3 (b)(1)(i)(b)

The main reason for selecting these pesticides is that of availability, efficacy and cost. This is typically the case of products such as chlorpyrifos and carbofurán that, although both RUPs, they are some of the most effective, and cheapest, insecticides and nematicides, as well as preferred products for ant control.

A usually overlooked criterion in the selection of pesticides is that of the formulation. On one hand, a simple way to reduce exposure risk to certain pesticides, such as chlorpyrifos, is to switch to formulations, like granules or pellets, that are not subjected to dangerous spills and drift. The same may be applicable to the reduction of the environmental impact of certain pesticides, such as the herbicide picloram, that by using injections to the bushy weeds, as opposed to sprays, there is a reduction on the total volume used and on the area impacted. Care must be exercised, however, because a granular or pellet formulation, being more attractive to them, could be more toxic to birds. So, the potential health and environmental impact of the various possible formulations from which to choose should always be considered, checked and analyzed when selecting a pesticide.

Recommendation No. 10*:* CAD should implement training and capacity development in SUP for the technical staff of the operators including the theme of pesticide selection. Variables such as product toxicity (using the color-coded labels), potential environmental impact, and the formulation are to be used among the criteria for selecting pesticides, additionally to efficacy, availability and cost.

4.10.3 Pesticides in the Context Of Integrated Pest Management Programs: 22 Cfr 216.3 (b)(1)(i)(c)

"Integrated pest management is USAID policy because it is the most effective, economical, and safest approach to pest control. IPM attempts to control pests in an economically and environmentally rational manner; it emphasizes non-chemical tactics which cause minimal disruption of the ecosystem"[11]. Pesticides should be used as the last resource for pest management after all other options have proven ineffective. Genetic (plants tolerance or resistance), biological (natural enemies), ethological (naturally occurring chemical disrupters), cultural (production practices), and mechanical (physical removal) are all preferred tactics to be used before resorting to chemical control (pesticides).

The general introduction on IPM possibilities for crops in the Anamichú project is shown in the Tables below; including lists of various possible pest problems of the crop, the management options available, the specific pesticides for the pest and some of the potential problems with the control options discussed. Finally, they list some technical support offers at the level of institutions and individuals and sources of information such as literature references and web sites.

[11] *USAID/AFR Guidance: Preparing PERSUAPs for Pesticide Programs in Africa.*

<u>Recommendation No. 11:</u> No crop should be promoted without first establishing an IPM program. CAD should install at least one crop specific IPM demonstration field in each of the intervention areas. To this effect CAD should work with the local UMATAS (Municipal Agronomic Technical Assistance Unit) and request the technical support of the institutions and individuals listed in the pest management offers.

4.10.4 Method of Application: 22 Cfr 216.3 (b)(1)(i)(d)

Although a few of the farmers may have access to stationary-pump spraying systems, somehow common in illicit crop growing areas, most of the pesticide application will happen through back pack sprayers. A common situation with these sprayers is that (a) they are not properly maintained and so they often leak with significant increases in the exposure of the applicator to pesticides, and/or (b) they are not properly set for the job with nozzles that are not the most appropriate for the particular type of pesticides (insecticides-fungicides or herbicides) being sprayed. Pesticide mixing is also an issue since often farmers do not follow all the precautionary measures and the concentrated, undiluted, pesticide increases the risk of the exposure. Commonly, in some rural areas, women and children may dangerously participate or stay close to the mixing, spraying and cleaning of the pesticide spray equipment. Finally, cleaning and disposing of pesticide excesses and of the product container needs to follow strict norms in order to minimize human and environmental risks.

<u>Recommendation No. 12:</u> CAD SUP program must include support for three essential components: (a) a comprehensive training program on "best practices" in SUP (see 3.11); (b) locally, climatically and technologically appropriate[12] protective clothing and equipment (gloves, masks, boots, etc.); and (c) maintenance and repair of spray equipment.

4.10.5 Possible toxicological hazards to humans or to the environment: 22 CFR 216.3 (b)(1)(i)(e)

A pesticide risk analysis was done on the close to 16 products that passed the first screening test (see Table No 26.). This analysis included a look at acute and chronic toxicity of the selected pesticides to humans, its eco-toxicity and potential for water contamination. As a result, recommendations were drawn as to the general and specific mitigation activities to be conducted in order to prevent and/or reduce the potential health and/or environmental impact of the various pesticides of the program. These mitigation activities are all encompassed within the comprehensive risk mitigation-SUP and IPM programs.

[12] This means adequate for the local climate (temperature and humidity) and possibly adapted from local materials (plastic bottle masks, plastic bags-gloves, etc.) instead of imported clothing materials.

<u>Recommendation No. 13</u>: CAD should socialize and share with project operators the results of the risk analysis of the pesticides and assure the full implementation of the mitigation measures recommended.

4.10.6 The Effectiveness of the Pesticides: 22 Cfr 216.3 (b)(1)(i)(f)

Recommendations for pesticide and other pest management tactics to be used in the various crops have been gathered and or double-checked with authoritative agricultural R&D institutions of Colombia. Additionally, literary references and relevant web sites were consulted. It is to point out that, in Colombia, CAD has an abundance of institutions that can provide technical information and support, as well as training in pest and pesticide management.

4.10.7 Compatibility of Pesticides with Target and Non-Target Organisms: 22 Cfr 216.3 (b)(1)(i)(g)

The pesticide risk analysis mentioned above, and described in this section, discuses the main risks the pesticides pose to non-target organisms in the environment, as well as some potential impact on target organisms, such as the likelihood of encouraging the development of pest resistance. Also mentioned in the table are some of the main direct mitigation measures to prevent and reduce the potential impact of the various pesticides to non-target organisms. The more general approaches to prevent and mitigate the health and environmental impacts of pest management activities, discussed elsewhere in this PERSUAP, are SUP and IPM.

4.10.8 Conditions Under Which The Pesticide Will Be Used: 22 Cfr 216.3 (b)(1)(i)(h)

The majority of the Colombian territory is formed by plains located below 500 meters above sea level (mosl). The country could be roughly divided into six great geographical regions. The Andean one, including three Andean mountain ranges and the "inter-Andean" valleys; two coastal regions, the Caribbean and the Pacific ones; the plains of Antoquia region; the Amazonian forests; and finally, an insular region.

The CAD project is being implemented in Southern Colombia, in the Departments of Putumayo, Huila, Cauca, Nariño, Caquetá, and in the North East Department of Norte de Santander. The commonality of all these territories is that they are all used for illicit crops, coca and poppy, cultivation.

Colombia's climate is tropical with patterns strongly influenced by the Andes. They are normally classified as: (a) <u>hot</u> for ca. 84% of the territory, reaching up to 1,000 mosl and with an average temperature of 24 º C; (b) <u>temperate</u>, at altitudes between 1,000 and 2,000 mosl, with an average

temperature of 17.5 º C; and (c) cold, with average temperature of 12 º C, and at altitudes of 2,000-3,000 mosl.

Ecologically, Putumayo, Caquetá, Norte de Santander, and Huila have a predominant pre-mountainous humid forest (Bh-pm) with close to 1000-2000 mm/yr, 18-24˚C, to low mountainous forest (Bh-mb) 2000-2500 mosl 12-18˚C. So these departments are in the hot climate area. Cauca, Nariño and Tolima have predominance of pre-mountainous to mountainous forests with a much more variable level of humidity and their climate is temperate to cold.

4.10.9 Availability and effectiveness of other pesticides and of non-chemical Controls: 22 CFR 216.3 (b)(1)(i)(i)

The use of pesticides in CAD projects will be inserted into comprehensive IPM programs. The "Decision Making Tree for IPM & a Guideline for SUP", discussed above, should help in making decisions if and when to resort to pesticides. But the matrices shown in this section present other available pesticide options and other pest management tactics for the crop and pest in question. There are, however, some problems with certain recalcitrant pests, such as ants, that are ubiquitous and pose a serious threat to certain crops, such as young trees, rubber, oil palm and heart of palm. Ants are not easy to control, and tend to draw to some of the most toxic chemicals, such as carbofuran and chlorpyrifos. Non chemical options are being suggested and proposed in the pest and pest management matrices for some of the crops.

An example of a non-chemical approach to a recalcitrant pest:

The Case Of Ants

- Attractive baits
- Nest destruction early on their development
- Prevention of the emergence of winged ants with covers
- Applying cal to change pH and destroy the fungi that is used as a food by ants
- Seeding castor bean (*Ricinus communis*) in rotation or inter-cropped (inhibits ants)
- Plough-in green manure (organic matter attracts them away from crop)
- Irrigation
- Mulching with neem or *Melia azedirach* materials (inhibit ants)

4.10.10 The ability and capacity of Colombia to regulate and control pesticide use: 22 CFR 216.3 (b)(1)(i)(j)

As stated above, Colombia is one of the most advanced countries in Latin America with respect to pesticide registration, regulation, and control. Colombia has very modern registration procedures, applies international standards and codes for pesticide labeling and has a system to follow up and control pesticide manufacturers and distributors that is only limited by the insecurity situation that the country has been living in for the past 25 years. The Instituto Colombiano Agropecuario, ICA, in charge of pesticide regulation, has taken more than 30 actions to ban hazardous pesticides or groups of pesticides, among which DDT, methyl bromide, canfechlor, captafol, all organochlorides, and toxaphene. Moreover, ICA requires that all Class IA and IB pesticides sold in the country have a back up 'prescription' written by a professional agronomist. Undoubtedly, the widespread insecurity in the majority of the rural territory of the country, and more specifically in the areas where CAD is active, limits the enforcing capacity of the GOC institutions. Although, the degree and effectiveness of controls in these areas is somehow limited and less than desirable, during the preparation of this PERSUAP we had first hand evidence of on going inspections to pesticide dealers in the Department of Putumayo, one of the most affected by the conflict.

Colombia pesticide regulation fits within its larger environmental framework, as per law 99 of 1993, "Fundamentals of the Colombian Environmental Policy". This law created the Ministry of Environment and the National Environmental System and established the "Environmental Licenses" which were further regulated by decrees 1728 of 2002 and 1180 of 2003.

The modernization of Colombia legislation related to pesticides begins with a major law, No. 09, approved by the National Congress in January 1979, regulating "hazardous substances, pesticides, and pyrotechnic articles". This is followed by decree No. 1843, from 1991, that further "regulates the use and management of pesticides". This decree defined and clarified terms and elements for the registration of pesticides, such as "efficacy", "contamination", "fumigation", "residue limits", "risk" and "toxicity", and officially adopted the four-classes WHO hazard classification of pesticides[13]. The same decree further regulated the manufacture and distribution of pesticides in the country.

More recently, Colombia has fully adopted the regional norms that derive from the actions taken by the 'Andean Community"(Comunidad Andina, CAN), to which Colombia is a signatory. The CAN, a result of the integration of Bolivia, Colombia, Ecuador, Peru and Venezuela, began activities in 1997 and in 1998, it passed the 'Andean Norm for the Registration and Control of Chemical Pesticides for Agricultural Use" (Decision 436). In it, the five Andean countries committed themselves to a normative towards a common system for registration, control and use of pesticides.

[13] The WHO classification: IA (extremely hazardous), IB (highly hazardous), II (moderately hazardous), III (slightly hazardous), and 'U' (improbable of presenting an acute risk in normal use). The LD_{50} used for chronic toxicity is either oral (O) o dermal (D). Colombia uses the same classification but classes are numbered I-IV.

CAN decision No. 436 established, among other things, (a) the requirements for pesticide registration; (b) norms for labeling and packaging; (c) maximum residue tolerances; and (d) norms for product efficacy research. Later, by resolution 532, of August 2001, CAN adopted the 'Technical Manual for the Registration and Control of Chemical Pesticides for Agricultural Use", which was fully developed and published in June 2002, in Resolution 630. This very comprehensive manual, includes detailed instructions to register chemical pesticides, with all the information requirements on the technical as well as the formulated material, as they relate to efficacy, human and eco-toxicology, residues, labeling, packaging, risks and the environmental management plan. Finally, ICA, as the GOC institution mandated with the registration and control of pesticides, fully norms the application of the CAN decrees internally to Colombia, in its resolution No. 00770 of March 2003.

Given this comprehensive and detailed pesticide regulation framework, again, the capacity of Colombia to regulate and control pesticides is only restricted by the general situation of the country, with somewhat weak institutional presence in certain isolated areas. This scenario, however, does not preclude, as we reported above, that ICA authorities are still enforcing some of the pesticide rules and regulations.

4.10.11 Provisions for Training in SUP and IPM: 22 CFR 216.3 (b)(1)(i)(k)

The CAD supported SUP training program should focus on risk reduction rather than on safe use of pesticides. In other words, instead of sending the message that pesticides could be used safely, the main goal of the training program should be to reduce the risk of farmers and their families by the careful analysis, and management, of the variables that affect the components of risk:

Risk = toxicity x exposure

This means that the "safer use", through risk reduction, begins before the "use" of the product, during its selection and preparation, and continues well after its use, in the field where the product is applied[14].

The SUP training could be sub-contracted from Bayer CropScience or from Servicio Nacional de Aprendizaje-Asociación Nacional de Industriales (SENA-ANDI). The former, a chemical company, runs a program called "Agrovida" that focuses on SUP for farmers or farmers families. Since women and children are in the higher vulnerability group, and women are often involved in the storage of pesticides as well as in cleaning farmer's clothes, they are an audience of extreme importance to be reached with messages of risk reduction. The second is a joint program between a GOC agency, SENA, and the association of industry and it offers two options, a two-day user

[14] For more details see in section 5.3 the Power Point presentation "A Practical Guide: Reducing Pesticide Risk", in Spanish.

targeted training course and a 5-day training-of-trainers event. CAD should consider training a few 'trainers', from the operators' staff, in each one of the regions where it operates.

The contents of the training program may need to be adjusted as per the various audiences but should include the themes listed in the training program attached, such as risk management, toxicology, labels, transporting, storage, mixing, spraying, cleaning, discarding, container management, applicators protection, etc.

Recommendation No. 14: Training on SUP should (a) focus on risk reduction; (b) reach the various important audiences: pesticide dealers, farmers, farmer families (women and children), staff of CAD project operators (trainers); (c) use the already available training offers in Colombia, such as the 'Agrovida' program, by Bayer CropScience, for farmers and their families (women and children), and/or that of SENA-ANDI joint training program for farmers and trainers.

As stated previously, in order not to transmit the false idea that pesticides, used safely, could be the sole solution to pest problems, SUP should not be promoted in isolation but rather in the context of a larger, more comprehensive approach to pest management, that of Integrated Pest Management, or IPM. Moreover, training in ecological and organic agricultural concepts and practices may always help CAD project operators to better understand, and even search for and experiment with, non-chemical options for pest control

Recommendation No. 15: CAD should promote a holistic agro-ecological approach, not only to pest management but also to crop production. Training, as well as technical support, offers in topics such as IPM, organic or ecological agriculture, are available in Colombia from various institutions. A list of the possible technical partners that CAD could resort to in the search for technical support follows.

Table 18 Possible Technical Assistance Sources for CAD

Institution	Crop	Theme
CIAT	Cassava, dry-beans, vanilla	Pest & crop management
Fedecacao	Cacao	Pest & crop management
Cenicaña	Sugar-cane	Pest & crop management
Cenipalma	Palm oil, heart of palm	Pest & crop management
Centro de Excelencia en Fitoprotección (CEF)	Tree tomato, lulo, maracuja, tomatoes, Amazonian fruits	Quarantine, pest management, pest risk analyses
Corpoica	Various	IPM in general; training
CONIF	Forest plantations, nurseries	Pest & crop management
IICA	Various	Ecological agriculture
IPGRI	Various	Quarantine & plant introductions
ICA	Various	Pesticides: registration & control; training
SENA	Various	IPM & organic agriculture; SUP; training
ANDI	Various	SUP training
Bayer CropScience	Various	SUP training: Agrovida
SGS / BioTrópico	Various	Certifications

4.10.12 Monitoring effectiveness and use of the pesticides: 22 CFR 216.3 (b)(1)(i)(l)

CAD is working with farmers associations and enterprises that have a relatively good level of organization. Most have very well trained field technicians that are regularly monitoring the pest management problems and the effectiveness of pest management methods being used. Open and regular reporting lines exist within CAD project operators and Chemonics to communicate issues such as new pests appearances as well as failures of the standard methods being used. Moreover, the Natural Resources and Environment group of Chemonics has the capacity for, and it is taking a lead role in, monitoring the most significant environment related variables of the project, including the effectiveness of pesticide.

4.11 ENVIRONMENTAL COMPLIANCE

Monitoring

A set of indicators for compliance with the recommendations of this PERSUAP, grouped by major themes is being proposed and presented in the table below.

Table 19 Monitoring Plan for PERSUAP Recommendations

Monitoring Theme	Recommendation	Indicator/s	Special Requirements
Sustainable alternative development	1	♦ Poly-cropping promoted & adopted by farmers ♦ System approach to alternative development in place, promoted & being implemented	Re-asses promotion of crops versus systems
Phytosanitary system for movement of plant materials	2	♦ ICA certification in place for internal movement of plant materials ♦ Quarantine in place for foreign materials	Establish links with ICA
Safer Use of Pesticides: hazard awareness, pesticide phase out, pesticide screening, training program, equipment support, risk analysis	3, 4, 5, 8, 9, 10, 12, 13	♦ Operators aware of colour band meaning in products & using info for selecting pesticides ♦ Operators pesticide request list regularly checked by CAD-NRE[15] team ♦ Trend for decreased 'red & yellow' band pesticides request lists ♦ No monocrotofos & paraquat by Dec '03 ♦ No methomyl & others by Aug 04 ♦ No chlorpyrifos, carbofuran & others by Aug 05 ♦ SUP KAP changed ♦ Parts & repairs offered for spray equipment	Training programs contracted & courses offered. Financial resources from CAD allocated for training & equipment
Integrated Pest Management: training (IPM, Eco), bio-pesticides, field demos	6, 7, 11, 14	♦ Ecological agriculture & IPM training contracted, offered, finished & KAP[16] monitored ♦ IPM demo fields installed & monitored for all crops ♦ Operators aware of & using bio-pesticides ♦ Operators using a wide range of pest management practices (more than 3 per pest)	Training programs contracted & courses offered. Financial resources allocated for IPM demos
Sustainability of Environmental Compliance	16	♦ Market-led environmental compliance through: organic agriculture, EurepGap, Illicit-to-Licit or other type of certification in place, or ♦ A third party system installed for auditing environmental compliance	Contacts made, bids open, resources allocated to initiate / catalyse both processes

4.12 LONG-TERM SUSTAINABILITY

Environmental compliance with Regulation 216, vis-à-vis pesticide issues could be assured through the auditing role of Chemonics NRE group. This group could possibly check the pesticide lists that CAD project operators regularly submit to Chemonics for approval and screen the pesticides appropriately. It may also field check project operators to inspect pesticide storage buildings, follow up some field operations and check on pesticide selection, mixing and use. [This has already been proposed in Recommendation No. 8]. However, since this monitoring is based mainly on a

[15] Natural Resources and the Environment
[16] KAP: Knowledge, Attitude and Practices.

'policing' approach to compliance, its sustainability is somewhat questionable. Although, an important 'educational' component, on SU and IPM, has been included in this PERSUAP, farmers may 'comply' with environmental regulations only and as long as the policing pressure is maintained. And this will only happen as long as USAID and Chemonics continue with the funding and implementation of CAD. But it may end right after that …

A fundamentally similar approach, but one that promotes a more direct participation, and so appropriation of environmental compliance issues, by the Colombian civic society, is that of allocating the 'policing' role to a 'third party' local NGO, or consultant. The profile of this auditor may be similar to the NGOs or consultants that Chemonics NRE group has already contracted to do the environmental studies of CAD productive activities. The local, Colombian, NGOs and consultant companies visited have demonstrated the capacity and the interest to undertake such work. Based on the table above, and on the 16 recommendations of this PERSUAP, CAD could develop a more detailed monitoring plan, agreed to among USAID, Chemonics, and the CAD operators, and assign a third party agency its verification following a system of open bids, as it is normally done in CAD.

A more sustainable path to environmental compliance may be that of a 'market-led' mechanism. If the market rewards an environmentally sound, clean, ecological or whatever the label is, produce then farmers will have to comply with certain production norms in order to be able to access and receive that reward. Third party certification is the key to this and not necessarily has to take the form of purely 'organic' production. Some of the Colombian certifying agencies contacted, such as *Biotrópico,* are working on organic produce certification, with the support of IFOAM, but also certify other producers. Among the latter are the coffee growers associated in COSURCA, exporting 'fair trade' coffee to the US market, in a project funded by USAID and UNDP. Other enterprises, such as the Swiss SGS, are certifying aromatic plant producers for EurepGap norms as well as Colombian flower exporters. Finally, the fruit growers association ASPROME, based in Cali, is exporting 'organic marmalades' to Europe, certified by Naturland-IFOAM, from fruits produced in a project funded by GTZ, the German Government and the European Community. The certification system is so simple as to work out a detail set of agreed rules, and corresponding indicators to track them, between producers, donors, project implementers and the certifying agency. The rules could easily be those established as environmental compliance requirements in Regulation 216, tracked by indicators such as pesticides registered with Colombia-ICA and US-EPA, no RUP pesticides, no class IA and IB products, etc. The 16 recommendations could be used as the basis for a framework for certification of USAID environmental compliance.

<u>Recommendation No. 16</u>: CAD is encouraged to seek a sustainable mechanism for pesticide environmental compliance. This could take the form of (a) a third party independent auditor of the use and management of pests and pesticides by project operators; and/or (b) a market lead environmental (vis-à-vis pesticides) compliance mechanism through a third party, independent, certification agency that assures 'organic', 'EurepGap', 'low-intensity pesticide usage', 'IPM-based', or Regulation 216-based agricultural production.

Training and Best Agricultural Practices Plan (BPA).Pursuant to Recommendations in the Pesticide Assessment Report and Safe Use Action Plan PERSUAP[17]

Insect Pest[18] are one of the principal problems affecting agricultural production and crops, decreasing productivity and/or product quality, resulting in important economic losses. Moreover, improper management and abuse of pesticides utilized in plague control may also lead to severe economic losses and negative environmental impacts (air pollution, contamination of soil and water resources) as well as loss of biodiversity and other negative effects. The combination of the negative factors mentioned above also cause the worst of all affectations i.e., the health of agricultural workers, their families and even, the health of consumers of agricultural products, is threatened.

CAD complies fully with USAID's provisions, the grantee agency, established in USAID's regulation 216. CAD has already carried out detailed environmental assessments of productive agricultural and transformation activities that are being or will be supported by the project. Such studies are known as Environmental Assessments (EA) and include, normally, an environmental diagnosis of the project site, a study of potential impacts caused by project activities and an environmental management plan that proposes prevention and mitigation measures of possible environmental impacts caused by development activities.

Specifically, CAD just completed phase 1 of a detailed study no pesticides currently used in more than 20 productive projects, including alternative methods to replace the use of pesticides available in Colombia for agricultural plague management. CAD is presently implementing phase 2 of this study covering almost 40 additional crops. This study, called "Pesticide Assessment Report and Safer Use Action Plan", or PERSUAP, follows closely the requirements stated in Regulation 216 of the United States Government applicable to each type of pesticide that may or will be used in CAD projects, planned or recommended, for crop plague management, as called for in 12 sections of Regulation 216, including:

[17] Draft No. 3, 29 October 2003

[18] The term Plague utilized through this document refers to its broad generic meaning, including insects, other arthropods and invertebrates, several pathogens, weeds and vertebrates.

1. Status of registration of pesticides in Colombia and with USEPA;
2. Basis for selection of pesticides for any particular application; why was such pesticide selected?
3. To which extent is pesticides part of Integral Plague Management systems?
4. Methods of application, including availability and use of appropriate equipment for application of pesticides and protective measures;
5. Acute long-range risks to humans and the environment, associated to proposed use of pesticides and available measures to reduce dangers thereof;
6. Efficacy of selected pesticides to meet expected results;
7. Compatibility of pesticides with natural ecosystems within their main objectives or other project objectives proposed;
8. Conditions under which pesticides will be used, including weather, flora, wildlife, geography, hydrology and soils;
9. Availability and effectiveness of other pesticides and/or non-chemical methods to control target plague(s);
10. Capability of operators and project implementers throughout Colombia to regulate or controlling distribution, storage, use and final disposal of pesticides;
11. Provisions for training of pesticide users and operators;
12. Provisions for effective monitoring, use and efficacy of pesticides.

The study mentioned above includes a list of (a) **banned pesticides**, prohibited in Colombia and in The United States (the donor country) or in both countries; (b) **products not approved,** or restricted in The United States, or products potentially harmful to human health or the environment in Colombia. A process of substitution of these products within a 0.5 – 1 year timeframe has been established; and (c) **approved products** that may be utilized in CAD projects. Beyond the strict control measures exerted by CAD on the use of pesticides in CAD projects, there is a commitment to promote the Best Agricultural Practice (BPA) production activities, including Integrated Plague Management (MIP) and Safe Use of Chemical Pesticides (USP), to contribute to sustainable alternative development. With this in mind, CAD developed a far-reaching training plan in support of BPA, MIP and USP.

4.13 OBJECTIVES

The Training Plan follows-up the application of PERSUAP recommendations. Its general objective is **to develop technical capacity within CAD project operators, at the technical and production levels, to implement clean environmental production systems contributing to minimize hazardous risks on producers and consumers health.** This plan was developed to assure that CAD not only complies with PERSUAP recommendations, but also will meet program indicators

and goals listed in the Monitoring Plan, in regards to use of pesticides and agricultural plague management activities carried out by project operators.

Specifically, the Training Plan aims to develop particular and broad technical skills in (a) **safer use of pesticides in agriculture**, such as appropriate approaches: ecological, economical and social; (b) **integrated management of agricultural Pest**, applying appropriate technological, economic and social systems approach; (c) **ecological or organic agricultural production**, if such approach is economically feasible within a production methodology context applicable to protection of the environment and human health. The proposal aims towards offering general training and specific training to technicians to strengthen their capability, thus enabling technicians to offer productive options to participant farmers, including social, economical and environmentally acceptable elements.

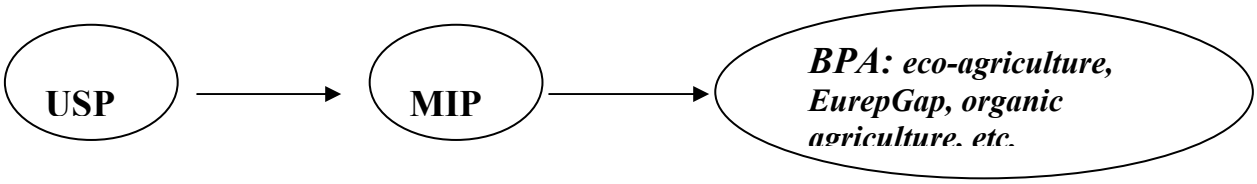

Table 20 Pest in Forest Plantations and Management Guide

General Comments: In general, pine trees are affected more by insect Pest, while Eucalyptus is more disease prone. Species promoted in the Anamichú project include: *alisio* (*Alnus* sp.), oak (*Quercus* spp.), laurel (*Myrica pubescens*), *motilón*, teck (*Tectona grandis*), *melina* (*Gmelina arborea*), red *ceiba* (*Bombacopsis* sp.), coffee walnut (*Cordia aliodora*), pink *guaycán* or *ocobo* (*Tabebuia rosea)*, *tara*, cedar (*Albizzia guachapele, Cedrela montana*), mahogany (*Swetenia* sp.). CONIF, (The National Corporation of Research and Forestry Development), is conducting a diagnostic study on basic elements in the MIP forestry program, including planting of mixed plantations.

Plague/s	Control Methods	Pesticides[19]	Problems
Diseases:			
Damping off: complex soil fungi (*Phytium, Rhizoctonia, Phythophtora,* etc.)	Chemical: seed treatment, disinfect soil. Cultural: low-density planting, avoid water deposits in pools, acid soils are preferred, avoid high organic deposits.		
Gills and radicular rotting: nematode *Meloydogine incognita*	Prevention Chemical: disinfected soils.		Occurs mostly in *Tabebuia* spp., *Cordia* sp., *Hevea brasiliensis*, *Ceiba pentandra* y *Erythrina* spp.
Crown gill: *Agrobacterium radiobacter pv. Tumefaciens*	Chemical: disinfect soils. Cultural: see damping off.		In *Eucalyptus* spp.
Death of stakes in rooting: Fungi complex (*Fusarium, Rhizoctonia*, etc.)	Chemical: stakes	Benomyl or sodium hypochloride Disinfect with Formaline	
Ascendant drying of Eucalyptus: *Mycosphaerella eucalypti*	None are effective.		

[19] Pesticides in this Table are not necessarily recommended for CAD projects. Check pesticide list tables.

Plague(s)	Control Methods	Pesticides	Problems
Eucalyptus blight (*Puccinia psidii*)	Genetic: resistant clones available.		
	Cultural: use precocious species.		
Descendant drying of Pines due to Diplodia (*Sphaeropsis sapinea*)	Genetic: spp. resistant		
	Cultural: early pruning, prune in lower temperature periods, remove pruning leftovers.		
Oak blight (*Prospodium bicolor*)	Chemical:	Triadimenol, mancozeb, oxicarboxin	
	Cultural: removal of attacked parts.		
Eucalyptus *Chancro* (*Cryphonectria* spp)	Genetic: resistance		
Drying of shoots of Eucalyptus *Botryosphaeria dothidea*)	Genetic: resistance		
Foliar stain of *Gmelina (Cercospora rangita)*	Cultural: weed control, reasonable planting densities.		
Necrotic stain of Eucalyptus *(Cylindrocladium* spp).	Genetic: resistant clones available.		
	Cultural: use precocious species.		
	Cultural: *raleos*, clearing, more distance between trees.		

Arthropods:			
Defoliants: see reference No. 2 below, pages 14-57	Cultural: management of canopy, apertures, clearing, promote secondary vegetation, etc.		The most important plague
	Microbiologic: for larvae.	*Bacillus thuringiensis*	
	Biologic: release *Telenomus* breed wasps.		
Suckers: see reference No. 2 below, pages 58-72			
Gill formers: see reference No. 2 below, page 73			
Sprout and shoot attackers: see reference No. 2 below, pages 74-77			
Root attackers: see reference No. 2 below, pages 78-79			

Plague(s)	Control Methods	Pesticides	Problems
Fruit and seed attackers: see reference No. 2 below, pages 81-83			
Trunk and branch attackers: see reference No. 2 below, pages 84-91			
Red army ants (*Atta* spp.)	Physical-Chemical: use bait to attract plague		
	Chemical:	Clorpirifós	PUR (Restricted use product) (see recommendation)
Escholitic in *Alisio*			
Weeds:			
Several	Mechanic: manual, with machete o scythe		
	Chemical:	Glifosato	

Technical assistance sources, training and contacts:

1. CONIF: Helena Moreno Beltrán, Entomologist, Responsible for the Forestry Protection Program, Bogotá, Conif@colomsat.net.co
2. CONIF: Carlos Barrera, Consultant, Bogotá, Tel. 341-7000

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Table 21 Pest in Beans (*Phaseolus vulgaris*) Farming and Management Guide

Plague(s)	Control Methods	Pesticides[20]	Problems
Diseases:			
Anthraxnosis (*Cholletotrichum*)		Chlotrothalonil, carbendazim	Found in hills, cold and humid climates
Angular stain (*Phaesamphtori*)	Chemical: vegetable extracts	*Swingla* spp.	Not registered yet in Colombia
Xanthomonas			
Arthropods:			
Weeds:			
Several	Chemical:	Glifosato, metolachlor, linuron	

Technical assistance sources, training and contacts:
1. Jairo A. Osorio, Head Investigator and Coordinator de MIP, Corporación Colombiana de Investigación Agropecuaria (Corpoica), Tibaitatá, Josorio@corpoica.org.co

[20] Pesticides in this Table are not necessarily recommended for CAD projects. Check pesticide list tables.

Table 22 Pest in Corn (*Zea mays*) Farming and Management Guide

Plague(s)	Control Methods	Pesticides[21]	Problems
Diseases:			
Mildeo velloso	Chemical: fungicides for treatment c seeds.	Benomyl	
Cercospora	Cultural: Management of crop residues		Occurs mostly in reduced farmin systems
Arthropods:			
Birds	Physical: Scarecrows and noise.		
Diatraea sp.	Cultural: weed control, grasses.		Problem increases at higher altitude plains.
Shoot worm *Cogollero* (*Spodoptera frugiperda*)	Cultural: good quality, vigorous seeds and good crop management. Control of grass weeds. Avoid planting in infested areas in the past.		Principal constraints at high altitude plains.
	Chemical:	*Clorpirifós*	PUR. See recommended use. For temporal use. Apply granulated form in sprouts only
	Microbiological:	*Baculovirus spodopterae*	Not registered yet in Colombia
Weeds			
Roundup	Chemical:	*Paraquat*	PUR. See recommendations. Use Roundup as necessary.

Technical Assistance Sources, Training and Contacts:
1. Jairo A. Osorio, Principal Investigator and Coordinator of MIP, Colombian Corporation of Agricultural and Cattle Research (Corpoica), Tibaitatá, Colombia Josorio@corpoica.org.co

[21] Pesticides in this Table are not necessarily recommended for CAD projects. Check pesticide list tables.

Table 23 Pest in Pastures (*Brachiaria* spp.) and Management Guide

Plague(s)	Control Methods	Pesticides[22]	Problems
Arthropods:			
Pissers or salivita (Pisser or spitter)	Mechanical: cutting at leave area level.		
	Chemical: application of insecticide a random.	Carbofurán (granules)	See recommendation
Weeds:			
Broad leave	Manual: hoe and machete		
	Chemical	Dicamba, diclorprop, 2,4-D, MCPA,	
Shrubs	Chemical:	Picloram	See recommendation

Technical Assistance Sources, Training and Contacts:

Estudios y Asesorías. 2002. Agro-pastoral Environmental Impact Assesment, Anamichu Project

[22] Includes the pesticidas being mentioned for pastures, requested by CAD project operators and/or recommended as part of pest management programs for these crops.

Table 24 Anamichú Crops Pesticides 23

Registration, Problem Analysis & Preliminary Decision [Reg. 216 point (a)]

Pesticide			Crop/s	Pest / s	Type of Problem, if any	Recommenda-tions & alternative/s
Technical Name[24]	**Trade Name[25]**	**Type & Tox Class[26]**				
Baculovirus spodopterae	None.	Virus: Microbial insecticide. TC not available yet.	Maize	*Spodoptera frugiperda*	Not yet registered neither in Colombia nor with USEPA	**Not to be used until registered at least in Colombia**
Benomyl	Benlate, Benomil, Benoagro	Fungicide.WHO TC: U; Colombia TC III.	Rubber Cassava Plantain Nurseries Heart of palm	*Microcyclus ulei, Phyllachora, Sphaceloma manihoticola, Mycosphaerella fijiensis* & *M. musicola* *Ralstonia solanacearum* Damping off *Colletotrichum* spp.	In the 'Bad Actor' list of PAN for possible carcinogenic & reproductive toxin.	**Approved.**
Captan	Captan, Merpan, Orthocide	Fungicide. WHO TC: U; Colombia TC: II	Heart of Palm Cassava Nurseries Potato	Various diseases *Xanthomonas* Damping off *Phythophthora*	In 'Bad Actor' list of PAN for possible carcinogenic & acute toxicity	**Aprobado.**

[23] Includes the pesticides being mentioned for the crops in question, requested by CAD project operators and/or recommended as part of pest management programs for these crops.
[24] Generic name or active ingredient.
[25] Name under which is sold in Colombia.
[26] Type of action: fungicide, insecticida, herbicide, etc. As per WHO classification: IA (extremely hazardous), IB (highly hazardous), II (moderately hazardous), III (slightly hazardous), and U (improbable of presenting an acute risk in normal use). The LD_{50} used for chronic toxicity is either oral (O) o dermal (D). WHO TC is that of the active ingredient. Colombia TC is that of the formulated product available in the country.

Pesticide			Crop/s	Pest / s	Type of Problem, if any	Recommenda-tions & alternative/s
Technical Name	**Trade Name**	**Type & Toxicity Class**				
Carbendazim	Carbendazim, Bavistin, Carbendacrop, Carbin, Colizym, Curacarb, Derosal, Duett, Etram, Helmistin, Kemdazin, Makio, Robendazim, Rodazim, SAAT Polka, Soler, Tecnomyl, Undazim, Agrozim	Fungicide. WHO TC: U; Colombia TC: III	Various. Dry beans	*Chollettrichum Phaesamtori.*		Approved.
Carbofuran	Furadan, Carbofed, Curater, Furalimor, Fursem, Carbofuran	Insecticide, nematicide. WHO TC IB; Colombia TC I	Cassava Rubber Plantain Nurseries Pastures Potato	White grubs (various species) *Erinnys ello* *Cosmopolites sordidos* Nematodes Mión *Premnotrypes* & others	RUP with USEPA (Except pellets /tablets). In 'Bad Actor' list of PAN: cholin-esterase inhibitor & acute toxicity. Organophosphate In IRED-04 list.	**Should not be used.** Excep pellets/tablets for 24 months maximum. Revise registration status in 2004.
Chlorothalonil (clorotalonil)	Bravo, Bravonil, Centauro, Clorotalonil, Clortocaffaro, Clortosip, Control, Daconil, Diclan, Echo, Helmonil, Pugil, Ridonate, Visado	Fungicide. WHO TC U; Colombia TC II	Rubber Dry beans Potato	*Colletotrichum gloesporoides* *Phythophthora* & rust	RUP with USEPA. In 'Bad Actor' lis of PAN for possi-ble carcinogenic & acute toxicity.	**Should not be used. Phase out in 24 months.**

Pesticide			Cop/s	Pest / s	Type of Problem, if any	Recommenda-tions & alternative/s
Technical Name	**Trade Name**	**Type & Tox Class**				
Chlorpyrifos (Clorpirifós)	Lorsban, Clorpirifós, Clorpiricol, Arriero	Insecticide, nematicide. WHO TC II; Colombia TC III	Plantain Oil Palm Cassava Rubber, Forest plantations Potato	*Metamasius hemipterus,* defoliant. Sting bugs. *Strategus aloeus* Ants (*Atta* spp.) & stem cutters (varias spp.) & white grubs. Erynnis ello.*Premnotrypes* & *Tecia*	RUP with USEPA In the 'Bad Actor' list of PAN: cholinesterase inhibitor. Organophosphate.	**Should not be used. Stop using formulations EC & WP within 12 months. Elimi-nate all formu-lations within a max of 24 month.** For the time being & to reduce risk, use only granular formulation.
Copper sulfate + lime [Copper sulfate + Lime (calcium carbonate)	Bordeaux mix	Cu sulfate: fungicide, algaecide, moluscicide. WHO TC II.	Heart of palm, oil palm Vanilla Nurseries		Bordeaux mix is not registered with USEPA but Cu sulfate & Ca carbonate yes, each separately.	Approved.
Dicamba	Banvel	Herbicide. WHO TC III; Colombia TC III.	Pastures	Weeds	In 'Bad Actor' list of PAN for repro-ductive toxin & possible water contaminant.	**Approved.**
Di-chlorofenoxi-acetic acid - 2,4-D	Agritron, Anikil, Artillero,Aminex, Desyerbe, DMA, Agrogen, Formula 40, etc.	Herbicide. WHO TC II; Colombia TC II ó III	Pastures	Weeds	In RED-2004 list.	**Approved**. But pendieng re-registration with USEPA in 2004.

Pesticide			Crop/s	Pest / s	Type of Problem, if any	Recommenda-tions & alternative/s
Technical Name	**Trade Name**	**Type & Tox Class**				
Dichlorprop (Diclorprop)	Malezafin (with 2,4-D)	Herbicide. WHO TC III; Colombia TC not available.	Pastures	Weeds	In 'Bad Actor' list of PAN for repro-ductive toxin.	Approved.
Gliphosate (glifosato)	Roundup	Herbicide. WHO TC U; Colombia TC III ó IV	Cacao Oil palm, Heart of palm, Ru-bber, Plan-tain, Fores-try plantat-ions	Cacao plants affected by *Rose-llinia pepo* Weeds in general		**Approved.**
Mancozeb	Manzate, Curzate, Dithane	Fungicide. WHO TC U; Colombia TC III	Plantain Oil palm & heart of palm Rubber Forestry Papa	*Ralstonia solanacearum* (Moko or maduraviche) Pudrición cogollo Mancha aerolada Mal suramericano *(Microcyclus ulei)* Oak rust. *Phythophtora*	In RED-04 list. In 'Bad Actor" lis of PAN for possible carcino-genic & repro-ductiv e toxin.	**Approved.** But pending re-registration with USEPA in 2004.
MCPA (only in mixes)	Tiller, Aniten	Herbicide. WHO TC III; Colombia TC not available	Pastures	Weeds	In RED-04 list. In 'Bad Actor" list of PAN for possible acute toxicity.	**Approved.** But pending re-registration with USEPA in 2004.
Oxycarboxin	Plantvax	Fungicide. WHO TC U; Colombia TC IV.	Oak Potato	Rust Rust		**Approved.**

Pesticide			Crop/s	Pest / s	Type of Problem, if any	Recommenda-tions & alternative/s
Technical Name	**Trade Name**	**Type & Tox Class**				
Picloram	Tordon, Closser, Grazón	Herbicide. WHO TC U; Colombia TC II, III, ó IV	Cacao Pastures	Diseased cacao plants c/*Rose-llinia pepo* Bushy weeds	RUP with US-EPA – except Tordon 101R	**Not to be used, in general.** If no substitute available, use only Tordon 101R.
Propineb	Format, Punto, Antracol	Fungicide. WH TC U; Colombia TC II ó III	Nurseries Potato	Damping off *Phythophtora*	In 'Bad Actor" list of PAN for repro-ductive toxin.	**Approved.**
Triadimefon	Bayleton	Fungicide. WHO TC III; Colombia TC IV	Rubber, Forestry plantations	*Thanatephorus cucumeris, Prospodium*	In 'Bad Actor" list of PAN for repro-ductive toxin.	**Approved.**

Table 25 Basis for the selection of Anamichú's Crop Pesticides[Addresses Reg. 216 point (b)]

Pesticide		Uses		Basis for Selection
Technical Name or Active Ingredient	**Trade or Commercial Name in Colombia**	**Crop**	**Pest**	
Benomyl	Benlate, Benomil, Benoagro	Rubber Cassava Plantain Heart of palm Nurseries	*Microcyclus ulei,Phyllachora, Sphaceloma manihoticola Mycosphaerella fijiensis & M. musicola Ralstonia solanacearum* Damping off	Cost. Availability. Effectiveness. Wide spectrum of pathogens controlled.
Captan	Captan, Merpan, Orthocide	Heart of Palm Cassava Nurseries Potato	Various diseases*Xanthomonas* Damping off *Phythophthora*	Cost. Availability. Effectiveness. Wide spectrum of insect pests controlled.
Carbendazim	Carbendazim, Bavistin, and many others	Dry beans	***Colletotrichum***	Cost. Availability. Effectiveness.
Carbofuran	Furadan, Carbofed, Curater, Furalimor, Fursem, Carbofuran	Cassava Rubber Plantain Nurseries Pastures	White grubs (various species) *Erinnys ello* *Cosmopolites sordidos* Nematodes Mión	Cost. Availability. Effectiveness. Wide spectrum of insect pests controlled.
Chlorotalonil	Bravo, Bravonil, Centauro, Visado, Clorotalonil, Clortocaffaro, Clortosip, Control, Daconil, Diclan, Echo, Helmonil, Pugil, Ridonate	Rubber	*Colletotrichum gloesporoides*	Cost. Availability. Effectiveness.
Chlorpyrifos	Lorsban, Clorpirifós, Clorpiricol, Arriero	Plantain Oil Palm Cassava Rubber, Forest plantations	*Metamasius hemip-terus,* defoliant.Sting bugs.*Strategus aloeus* Ants (*Atta* spp. stem cutters (various spp.) white grubs. Erynnis ello.	Cost. Availability. Effectiveness. One of the very few products used for ant control. Wide spectrum of insect pests controlled

Pesticide		Uses		Basis for Selection
Technical Name or Active Ingredient	**Trade or Commercial Name in Colombia**	**Crop**	**Pest**	
Copper sulfate + cal (Bordeaux mixture)	Bordeaux mix	Heart of palm, oil palm Vanilla Nurseries	*Pestalopsis sp.* *Colletotricum sp.* *Fusarium oxysporum & Phytophthora sp.* Damping off	Effectiveness. Limited health & environmental impacts. Easiness to prepare.
Dicamba	Banvel	Pastures	Weeds	Cost. Availability. Effectiveness.
Di-chloro-fenoxi-acetic acid (2,4-D)	Agritron, Anikil, Artillero,Aminex, Desyerbe, DMA, Agrogen, Formula 40, etc.	Pastures	Weeds	Cost. Availability. Effectiveness.
Gliphosate	Roundup	Cacao Oil palm, Heart of palm, Rubber, Plantain, Forestry plantations	Cacao plants affected by *Rose-llinia pepo* Weeds in general	Effectiveness. Reduced health & environmental impacts. Cost. Availability.
Mancozeb	Manzate, Curzate, Dithane	Plantain Oil palm Rubber Heart of palm	*Ralstonia solanacearum* (Moko or maduraviche) Stem rottening Round spot Southamerican disease*(Microcyclus ulei)*	Cost. Availability. Effectiveness.
MCPA	Tiller, Aniten	Pastures	Weeds	Cost. Availability. Effectiveness.
Oxycarboxin	Plantvax	**Forestry: oaks**	Rust	Cost. Availability. Effectiveness.
Picloram	Tordon, Closser, Grazón	Cacao Pastures	Diseased cacao plants c/*Rose-llinia pepo* Bushy weeds	Cost. Availability. Effectiveness.
Triadimefom	Bayleton	Rubber	*Thanatephorus cucumeris*	Cost. Availability. Effectiveness.

Table 26 Crops in the Anamichú Project - Pesticides Risk Analysis

Pesticide[27]	Acute Tox Class[28]	Type	Chronic Toxicity	Eco-toxicity	Groundwater Contamination Potential	Mitigation of risks / Comments[29]
Benomyl	WHO: U; Colombia: III	Fungicide	Possible carcinogenic & inducer of developmental & reproductive toxin promoter. Suspected endocrine disrupter.	Moderately toxic to birds & highly toxic to fish	There is insufficient data regarding potential ground water contamination.	Uses of benomyl should be controlled vis-à-vis possible environmental impacts on non-target spp.
Captan	WHO: U Colombia:II	Fungicide	Possible carcinogenic , acute toxicity. Unlikely reproductive effects. Non mutagenic, non teratogenic.	Non toxic to birds & bees. Very high toxicity to fish. Moderate toxicity to mollusks, insects & zooplancton.	Low persistence in soils & water bodies. Degrades rapidly in neutral water.	Use with precaution protecting humans.
Carbendazim	WHO TC: U; Colombia TC: III	Fungicide	Possible carcinogen & suspected endocrine disrupter.	Moderately toxic to birds & highly toxic to fish	There is insufficient data regarding potential ground water contamination.	Uses should be controlled vis-à-vis possible environmental impacts on non-target spp.

[27] Technical name or active ingredient.
[28] As per WHO classification: IA (extremely hazardous), IB (highly hazardous), II (moderately hazardous), III (slightly hazardous), and U (unlikely to present acute hazard in normal use). The LD_{50} used for acute toxicity is either oral (O) or dermal (D). Colombia uses the same scale but classes numbered I-IV.
[29] General mitigation tactics to (a) reduce human exposure risks: protective clothing (mask, hat, glasses, long sleeves shirt, long pants, boots, gloves, no spray close to water bodies, to bee hives, to bird nesting areas, avoid windy days, etc.) are part of a more general SUP.

Pesticide	Acute Tox Class	Type	Chronic Toxicity	Eco-toxicity	Groundwater Contamination Potential	Mitigation of risks / Comments
Carbo-furan	WHO: IB; Colombia: I. High acute toxicity	Insecticide, nematicide	Organophosphate = cholinesterase inhibitor. Liquid formulations pose serious threat to applicators (RUP reason). Highly toxic by ingestion & inhalation & moderately by dermal exposure.	Granular formulations pose serious threat to birds & possible other animals (RUP reason). Highly toxic to birds & fish.	High water solubility & so potential for ground water contamination.	RUP. Carbofuran uses should be minimised & carefully controlled to prevent human & environmental contamination. In IRED-04. Revise registration status in 2004
Chlorotalonil	WHO: U; Colombia: II.	Fungicide	Possible carcinogenic; unclear potential. No other effects except the fact that it is a strong eye & skin irritant	Non toxic to birds & bees. Highly toxic to fish, aquatic invertebrates & marine organisms.	Some potential but yet unclear.	RUP. Chlorothalonil should be used carefully & in supervised manner to prevent human health & environmental impacts
Chlorpyrifos	WHO: II; Colombia: III	Insecticide, nematicide	Organophosphate = cholinesterase inhibitor. No other adverse effects except those associated to central nervous system.	May be toxic to some plants, e.g. lettuce. Mod-very toxic to birds & very highly toxic to fish & aquatic organisms	Unlikely to leach & contaminate water.	RUP. There is a 24 hour minimum re-entry time for field treated with it. Applications should be carefully supervised to prevent human & environmental exposure.
Copper sulfate + cal (Bordeaux mixture)	WHO: II; Colombia: not available	Fungicide	No evidence for chronic effects in humans is available.	No evidence for adverse effects on the environment.	No evidence for potential for water contamination.	

Pesticide	Acute Tox Class	Type	Chronic Toxicity	Eco-toxicity	Groundwater Contamination Potential	Mitigation of risks / Comments
Dicamba	WHO: III; Colom-bia: III	Herbi-cide	Reproductive toxin. Otherwise no carcinogenic, mutagenic, or teratogenic effects have been noted.	Practically non-toxic to birds & low toxicity to fish. Not toxic to bees.	Highly soluble in water & does not bind to soil so it is a potential water contaminant	Should be used with care to prevent contamination of water bodies.
Di-chloro-fenoxi-acetic acid (2,4-D)	WHO: III; Colom-bia: II or III	Herbi-cide	Possible carcinogenic & suspected endocrine disrupter. Possible reproductive effects. Acutelly may be a serious eye & skin irritant.	Possible accumulation in the environment with effects on wildlife. Unclear status.	Potential contaminant	In IRED-04. Revise registration status in 2004. Handle with care to avoid skin & eye irritation
Gliphosate	WHO U; Colom-bia: III-IV	Herbi-cide	No evidence of any carcinogenic, teratogenic, mutagenic effects.	Slightly toxic to birds, non toxic to fish & bees.	Unlikely due to soil adsorption.	
Mancozeb	WHO: U; Colom-bia: III	Fungi-cide	Possible carcinogenic, reproductive toxin promoter & endocrine disrupter	Moderately to highly toxic to fish, slightly toxic to birds & not toxic to bees	Not a possibility.	In IRED-04. Revise registration status in 2004. Use with care to minimise workers exposure.
MCPA	WHO: III; Colom-bia: not availa-ble	Herbi-cide (in mixes only)	Possible carcinogen. Significant reproductive effects have been observed in rats. Weakly mutagenic.	Not toxic to fish, slightly toxic to bees & moderately toxic to birds	Not likely. It is degraded rapidly by water micro-organisms	In RED-04. Revise registration status in 2004. Protect applicators.

Pesticide	Acute Tox Class	Type	Chronic Toxicity	Eco-toxicity	Groundwater Contamination Potential	Mitigation of risks / Comments
Oxy-carboxin	Plant-vax	Fungicide.	**Non teratogenic, non mutagenic, non carcinogenic.**	**Highly toxic to fish. Relatively non toxic to birds & bees.**	**Not likely. It breaks down rapidly in water.**	**Protect fish.**
Picloram	WHO: U; Colom-bia: IV (G)	Herbi-cide	Non teratogenic, weakly to no mutagenic, weakly carcinogenic.	Slightly toxic to birds & fish & not toxic to bees. Hazard for no-target plants, crops & others	Potential for ground water contamination.	RUP with USEPA except Tordon 101R formulation. Use only this one.
Triadime-fom	WHO: III; Colom-bia: IV	Fungi-cide.	Possible carcinogenic, possible reproductive toxin promoter & suspected endocrine disrupter	Slightly toxic to birds & fish & not toxic to bees.	Potential for ground water contamination	Protect applicators & minimise exposure

Table 27 Banned Pesticides

Pesticides PIC, Prohibited, Restricted or Cancelled In Colombia and/or in the USA[30]

Pesticide[31]	PIC List[32]	Registration status in[33]	
		Colombia	United States
Aldrin	Yes	P (1974 in tobacco), C (1988)	No
BHC		P (1974 in tobacco), P (1978 in coffee), P (1993)	No
Methyl Bromide		P except for quarantine (1996)	RUP
Canphechlor		P (1978 in coffee), C (1988), P (2000)	No
Captafol	Yes	P & C (1989)	No
Chlorinated in tobacco		P (1974)	No
Chlordane		P (1974 in tobacco), C (1988), P (1993)	No
Chlordimeform		P (1987), C (1988)	No
DBCP (di-bromo-chloro-propane)		P (1982)	No
DDT		P (1974 in tobacco), P (1978 en café), P except in health (1986), P (1993)	No
Dicofol		P (1993)	Yes
Dieldrin		P (1974 in tobacco), C (1988), P (1993)	C
Dinoseb		P (1987)	C
Dodecachlor (Mirex)		P (1993)	C
2,4,5-T & 2,4,5-TP		C (1979)	C
Endosulfan		P except for coffee borer (1993 & 1997)	RUP
Endrin		P (1974 in tobaco), P (1985)	No
Ethylene di-bromine (EDB)		P (1985)	No
Fonofos		P (1992)	No
Fosfamin		C (1997)	RUP?
Mercury Fungicides		C (1974)	No
Heptachloro		P (1974 in tobacco), C (1988) P (1993)	No
Isazofos		C (1996)	No
Leptofos (Phosvel)		C 1977	No
Maneb		C (1989), P (1993)	Yes

[30] It is not an inclusive list for the US or PIC. It is base don Colombian prohibited products.
[31] Technical name.
[32] The list of products for "**Previous International Consent**", or "**PIC**" (1998), of the United Nations Environment Program (UNEP) and the Food and Agriculture Organisation (FAO). FAO leads in relation to pesticides. Alow importing countries to better know the potentially hazardous products that may be sent.
[33] "**P**" = "**Prohibited**" = "**Banned**" = the uses of the product are not permitted in the country, by explicit decision of the regulatory agency. "**R**" = "**Restricted**" = in the sense of the USEPA, it is a pesticide that can specific prohibition. **No**: not registered.

Pesticide	CIP List	Registration status in	
		Colombia	United States
Lindane		P (1978 in coffee), C (1993), P except in health (1993), P (1997)	RUP
Metamidophos	Yes	Yes	Yes
Monocrotophos	Yes	Yes	Yes
Organochlorines in general		P (1974 in tobacco), P (1978 in coffee)	No
Paraquat		P aerial application (1989)	RUP
Parathion & methyl-parathion	Yes	R only for cotton & rice (1991)	RUP
Pentachlorophenol (PCP)		P (1993)	GUP & RUP (treatment of wood)
Posphamidon	Yes	No	No
Toxaphene		P (1975 in tobacco), P (2000)	No
Zineb		P (1993)	No

SECTION 5 ENVIRONMENTAL CONSEQUENCES

5.1 IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL IMPACT

5.1.1 Overview

The practice of agriculture requires the use of techniques and materials that will improve quality and quantity of produce. The aim is to increase its productivity and income; however, the application of modern practices generate a series of consequences which are mostly positive, but may also have some negative effects that could alter, to different degrees, the natural conditions and resources.

5.1.2 Methodology

As mentioned before, the methodology used for the identification and assessment process of environmental impacts follows the Terms of Reference of the contract, where the Leopold Matrix[34] technique is suggested; this was the first method employed by the Geological Service of the Ministry of the Interior of the United States, since 1971. The original procedure has been augmented and complemented with the Assessment techniques suggested by the Ministry for the Environment of Colombia and officers of Chemonics.

The methodology is based on a matrix analysis scheme, which contains the altered environmental factors and correlates them to every phase of the project's activities. The impact can be adverse when the project activity alters the natural resource negatively and it can be positive if it impacts the resource to its favor. For example, plague control activities (column G) interact with other environmental components such as soil, and this in turn relates to the slope at which planting is taking place, potentially generating landslides in steep zones (cell 8). To indicate the interrelationships between the activities and the referenced components of the environment, a color-coding is used (blue and orange), aside from the text (letters and numbers), both making reference to the type of alteration that can be generated between them.

There can be activities that do not generate impact on the resources. These have been identified as innocuous and are not contemplated in the matrix, so the cells appear blank. In the stage of environmental assessment these impacts will not be considered either.

With the purpose of establishing a magnitude grading of the interaction that occurs between the project's activities and the identified components, valuation scales have been established depending on the relevance of each activity in relation to the others of the same phase. The process begins with the counting of beneficial (B) and adverse (A) impacts; the sum of both is associated to the importance given to each activity; then, an arithmetic balance is calculated between the positive and the negative results; an overall negative

[34] **Instituto Tecnológico Geominero de España. Evaluación y Corrección de Impactos Ambientales, Madrid, 1991**

result indicates that for a specific activity the impact is adverse, while a positive one would mean the opposite. This balance is depicted graphically at the bottom of the matrix. The identification analysis was also made along the rows of the matrix to find the quantified value of the interaction of the impacts identified for each resource. The operation is defined by the equation :

$$VI = RA * (\sum_{i}^{n} B_i - \sum_{i}^{n} A_i)$$

Where :

VI = Value of the Interaction
Bi = Beneficial Effect
RA = Relevance of the activity (1 to 10 for columns, and 1 to 5 for rows)
Ai = Adverse Effect
i = Number of order of Impact

It is worth noting that the assessment of impacts included those existing prior to the implementation of the project. For the Assessment another set of criteria were classified and used in another Leopold matrix, to complement the one presented above.

- Nature of the impact : Positive, (beneficial), or Negative, (adverse), in relation to the consequences of its occurrence.
- Type : Direct or indirect; the impact is direct if it occurs by itself, and indirect if it is brought by another medium such as wind rain a vehicle, people, etc.
- Duration : Temporal or Permanent.
- Scope : Local or extensive. Whether it occurs solely in the direct area or not.
- Tendency : Reversible or irreversible, which measures the possibility of controlling or reversing the impact through management measures.
- Synergy : Yes or no. Refers to the chain reaction of other impacts.
- Probability of occurrence : High or low.
- Magnitude : Classifies the impact area of effect and power in relation to other occurrences as high, low or medium.
- Recommended management measure : The possibility of recommending the most adequate management measure is considered. The purpose of these measures tends to be to correct, mitigate, compensate or prevent the impact.

5.1.3 Environmental Assessment Matrix

For the columns where the project's activities are located, the scale of importance (RA) are in the range from 1 to 10; this value was assigned considering the relevance of each activity in relation to the others. The following table presents the values of RA that were established for the Anamichú project.

Table 28 Values of Environmental Relevance for the Activities in the Anamichú Project

PHASE	ACTIVITY		NUMBER	DESCRIPTION	RA
PHASE OF ESTABLISHMENT AND MANAGEMENT	GREEN HOUSE	Germination	A	Seeding and seedlings preparation	8
		Seedlings	B	Transplantation from seedlings to individual plants	9
	LAND PREPARATION	Hole Digging	C	Excavation for seeding and stake implantation	5
		Implementation of Drainage	D	Preparation of Water Supply System	4
	CULTIVATION	Transplantation	E	Transplantation of Seedlings	4
		Sowing	F	Establishment of plants in the plot	2
		Construction of tutors	G	Preparation and installation of stakes	3
		Pest Control	H	Application of Pest Control Chemicals	4
		Weed Control	I	Application of chemical compounds to kill weeds	4
		Sickness Management	J	Application of compounds to prevent sicknesses	4
		Irrigation	K	Construction and maintenance of irrigation tools	3
		Fertilization	L	Application of soil products to enhance plant growth	3
	CATTLE	Farmyard Management	M	Activities to manage two heads of cattle	9
		Enclosed shed Management	N	Activities to manage 20 chickens	9
PRODUCTIVE PHASE		Harvesting - Recollection	O	Activities to hoard products	6
		Management of Harvesting and Post Harvesting	P	Actions after harvesting is performed	3
		Depulping	Q	In coffee processing it is the activity that takes away the pulp that covers the coffee grain	3
		Fermentation	R	In coffee processing it is the activity that takes away the mucilage that covers the coffee grain	3
		Washing	S	In coffee processing it is the activity that eliminates the mucilage that covers the grain	4
		Drying	T	In coffee processing it is the activity in which the washed coffee grains are exposed to the sun	2
		Hoarding and transportation	U	Recollection of the product and transportation to consumer points	3
		End of the Cycle	V	Activities related to management of waste, abandonment and preparation of new cycle	5
				TOTAL	100

The value of environmental relevance assigned to the rows (where impacts are located in) range from 1 to 5. These values were assigned considering which one showed greater vulnerability during the development of project activities. The following table presents the values of RA considered for each one of the environmental referred aspects.

Table 29. Values of Relevance in the Environmental Assessment

ELEMENT	COMPONENT	NUMBER	ASPECT OF REFERENCE	RA
PHYSICAL ENVIRONMENT	AIR	1	Air pollution for land cleaning and application of Agrochemicals	1
		2	Generation of odors for management of Corrals and Sheds	1
		3	Generation of odors for agrochemicals	1
	WATER	4	Detriment of water quality for seedlings, preparation of drains and application of agrochemicals	3
		5	Alteration of drainage	3
		6	Physicochemical contamination due to run-off from unprotected areas	3
		7	Discharge Reduction at the rivers	4
	SOILS	8	Landslides in step areas	4
		9	Alteration of micro flora and microfauna due to the use of pesticides	3
		10	Damage to agricultural value of the land because of inappropriate cultural practices	4
		11	Soil scouring in gullies and channels near cultivated areas.	4
		12	Soil contamination due to waste from corrals and sheds	4
		13	Soil contamination due to agrochemicals	4
		14	Accumulation of large volumes of material	4
		15	Enlargement of agricultural frontier	
		16	Physicochemical quality of the soil	5
BIOTIC ENVIRONMENT	**FLORA**	17	Deforestation of the land	2
		18	Toxicity to agrochemicals	4
		19	Loss of valuable species of flora	3
		20	Landscape Alteration	2
	FAUNA	21	Structure of wild fauna	1
		22	Endangered species	1
		23	Affectation of fauna populations due to contamination	1
		24	Migration of fauna due to the activities of the project	2
		25	Risk to workers for contamination with chemicals	3
		26	Alteration of vital cycles due to application of chemicals	1
SOCIAL ENVIRONMENT	**CULTURAL**	27	Technical Assistance	4
		28	Institutional follow-up	4
		29	Environmental education	4
		30	Lack of a system of environmental monitoring	4
		31	Security in alimentation	4
	ECONOMICS	32	Generation of income	4
		33	Demand of natural resources	4
		34	Enterprise organization	4
TOTAL				100

Based on the matrix depicted above, the activities can be ordered vertically according to the degree of negative affectation that they generate on the different components considered. The order of activities, including cultivation and processing, are categorized from the one with the most negative impacts to the one with the least, as follows:

- For the installation and assembling phases, the activity of seedling preparation has the greatest negative values (-126), followed by the activities of corral and shed management and pest control (-72, -54 and –52, respectively). In this phase of the project there are interaction with benefic results like germination, transplantation, weed control, irrigation and fertilization.

- In the production phase of the project, mostly beneficial interactions are presented;, with values between +9 and +30. The activities with higher interaction values will require a more complete monitoring and follow up package within the Environmental Management Plan in a later phase.

Evaluating the matrix in a horizontal direction, it is possible to determine which environmental components are the most affected by the group of activities developed both for the installation and production phases. The order is as follows:

- For air, the interactions indicate smaller effects than the those assigned to other resources; with values of –5 for air pollution during land cleaning and during the application of chemicals, with a secondary effect due to potential odors.

- The greatest impact on water resources is the reduction of water in the rivers (-44), followed by the alteration of drainage (-33), then physicochemical contamination by run off from unprotected areas, and decreased water quality during seedling upbringing and application of agrochemical compounds, (-27).

- For soil, the most important effect is scour; formation of gullies, and drainage channels near the cultivated fields, (-20), followed by landslides in steep zones, (-16) and increase of the farming frontier (-12). Other impacts show great differentiation with interactions between –4 and –12.

- For the biotic environment, the most negative interaction deals with deforestation (-20), followed by loss of valuable fauna species (-18), and toxicity due to agrochemical compounds (-16), followed by loss of wild species of fauna and endangered species (-12).

In the socioeconomic component, the interactions reflect the beneficial character of the project since most of the balances yield positive values. The most significant of them are technical training and assistance, institutional follow-up, food security, training in enterprise management and environmental education (88). The following tables present the values of the interaction reported both for columns, (project activities), and for rows, (environmental aspects):

Table 30 Values of Interaction Registered for the Activities of the Project

PHASE	ACTIVITY		No.	Quantification of Environmental Interaction			Value of Interaction
				A	B	Innocuous	
INSTALLATION AND ASSEMBLING PHASE	GREEN HOUSE	Germination	A	3	6	25	24
		Seedlings	B	20	6	8	-126
	LAND PREPARATION	Hole Digging	C	13	7	14	-30
		Implementation of drainage	D	11	6	17	-20
	CULTIVATION	Transplantation	E	2	7	25	20
		Seeding	F	5	6	23	2
		Construction of Tutors	G	10	6	18	-12
		Pest Control	H	19	6	9	-52
		Weed Control	I	6	8	20	8
		Sickness Management	J	20	6	8	-56
		Irrigation	K	6	7	21	3
		Fertilization	L	9	8	17	-3
	NURSING	Management of Corrals	M	14	6	14	-72
		Management of Sheds	N	12	6	16	-54
PRODUCTIVE PHASE		Harvesting – Recollection	O	3	6	25	18
		Management of Harvesting and Post Harvesting	P	3	6	25	9
		Depulping	Q	3	7	24	12
		Fermentation	R	8	6	20	-6
		Washing	S	8	6	20	-8
		Drying	T	1	6	27	10
		Hoarding and Transportation	U	3	6	25	9
		End of the Cycle	V	1	7	26	30
TOTAL				180	141	427	748

Table 31 Values of Interaction Registered for the Environmental Aspects of Reference

Component	No.	Environmental Aspect of Reference	Quantification of Environmental Interaction			Value of Interaction
			A	B	Innocuous	
Air	1	Air pollution for land cleaning and application of Agrochemicals	5	0	17	-5
	2	Generation of odors for the management of Corrals and sheds	4	0	18	-4
	3	Generation of odors due to agrochemicals and other actions of the project	5	0	17	-5
		Subtotal	14	0	52	
Water	4	Water quality deterioration due to seedling preparation, drainage and agrochemical application	9	0	13	-27
	5	Drainage Alteration	11	0	11	-33
	6	Physicochemical contamination due to run-off from unprotected lands	9	0	13	-27
	7	Discharge Reduction at the rivers	11	0	11	-44
		Subtotal	40	0	48	
Soil	8	Landslides in step areas	7	3	12	-16
	9	Alteration of microflora and microfauna due to the use of pesticides	3	0	19	-9
	10	Diminishing agrological characteristics of soils due to poor cultivation practices	4	1	17	-12
	11	Soil scouring in gullies and channels near cultivated areas.	5	0	17	-20
	12	Soil contamination due to waste from Corrals and sheds	2	0	20	-4
	13	Soil contamination due to agrochemicals	8	0	14	-8
	14	Accumulation of large quantities of materials	3	0	19	-6
	15	Enlargement of Agricultural Frontier	5	0	17	-15
	16	Alteration of physical-mechanical and chemical conditions of the soil	5	3	14	-10
		Subtotal	42	7	149	
Flora	16	Toxicity to agrochemicals	8	0	14	-16
	17	Deforestation of the land	5	0	17	-20
	18	Loss of Valuable species	6	0	16	-18
	19	Landscape Alteration	7	1	14	-12
		Subtotal	26	1	61	

Fauna	20	Structure of Wild Fauna	5	1	16	-12
	21	Endangered Species	3	0	19	-12
	22	Effects on populations due to the contamination of the environment	3	0	19	-9
	23	Migration of fauna due to the activities of the project	6	0	16	-6
	24	Risk to workers for contamination with chemicals	4	0	18	-12
	25	Alteration of vital cycles due to application of chemicals	4	0	18	-8
		Subtotal	25	1	106	
Sociocultural	26	Technical Assistance	0	22	0	88
	27	Institutional follow-up	0	22	0	88
	28	Environmental education	0	22	0	88
	29	Lack of a system of environmental monitoring	21	0	1	-84
	30	Security in alimentation	0	22	0	88
		Subtotal	21	88	19	
Economics	31	Generation of income	0	22	0	88
	32	Demand of natural resources	12	0	10	-48
	33	Enterprise organization	0	22	0	88
		Subtotal	12	44	10	

5.2 ENVIRONMENTAL ASSESSMENT MATRIX

The environmental assessment matrix is an interdisciplinary analytical process to obtain an objective judgment regarding the consequences brought about by the impacts derived from the execution of the activities of a project. The identification and Assessment of the modifications introduced on a given set of prefixed environmental indicators are classified below.

Table 32 Identification and Assessments, Environmental Indicators

CRITERIA FOR CLASSIFICATION	QUALITATIVE VALUATION	QUANTITATIVE VALUATION
Character of Impact	Positive	+
	Negative	-
Type	Direct	0.70
	Indirect	0.30
Duration	Temporal	0.20
	Permanent	0.80
Scope	Local	0.40
	Extensive	0.60
Tendency	Reversible	0.30
	Irreversible	0.70
Synergy	YES	0.80
	NO	0.20
Probability of occurrence	HIGH	0.50
	MEAN	0.30
	LOW	0.20
Magnitude	HIGH	0.50
	MEAN	0.30
	LOW	0.20

The equation that relates impacts with respect to their value and from which one obtains the Environmental Quality CA is as follows :

$$CA = CI * PB[\alpha(DR * TD * MG) + \beta(SG * AL * TP)]$$

Where :

CI = Character of Impact, + or - pending of adverse or beneficial nature
CA = Environmental Quality
MG = Magnitude
PB = Probability of occurrence
AL = Scope
DR = Duration of the Impact
TP = Type
□ = Coefficient of importance (For DR, TD y MG = 60)
TD =Tendency
□ = Coefficient of importance (For SG, AL y TP = 40)
SG = Synergy

In this way, an "Environmental Categorization "EC" has been established, which can be related to an "Environmental Alteration" level as follows :

Table 33 Environmental Qualification/Alteration Standards

ENVIRONMENTAL QUALIFICATION (EC)	ENVIRONMENTAL ALTERATION (EA)
>10.0	**VERY HIGH**
8.0-10.0	**HIGH**
6.0-8.0	**MEAN - HIGH**
4.0-6.0	**MEAN**
3.0-4.0	**MEAN - LOW**
1.0-3.0	**LOW**
<1.0	**VERY LOW**

The values of the preceding table can be both positive and negative impacts, depending on the value of EC as an absolute value. The most relevant affectations on the environment, potentially generated by the project, can be summarized as follows:

5.3 PHYSICAL ASPECTS

The different lines of production that constitute the project generate effects over the biological, physical and socioeconomic components, during the various phases of development. For permanent crops the common tasks are: germination, seedlings, hole making, layout, drainage implementation and transplantation. In other crops the tasks are: land preparation, drainage implementation, weed control, pest and sickness control, irrigation, fertilization, harvesting and post harvesting activities, recollection, transport and elimination of the remaining roots. For coffee crops, processing must be considered, (depulping, fermentation, washing and drying) as part of the farming procedures.

The effects caused by coffee processing were identified and causing mayor impacts on the biological and physical environments due to the variety of activities that are carried out in this phase, and that generate water, soil and air contamination.

In other crops and production lines, the impacts with greater magnitude are generated by use and handling of agrochemical products, although the project is directed toward organic agriculture, and hence avoiding the use of chemicals for fertilization or pest control.

Another aspect of importance is the identification of impacts related to water and soil contamination originating in an inadequate handling of solid residue (i.e. pulp, *gallinaza*, and manure), resulting from the coffee, cattle and other animal processes.

5.4 IMPACT ON THE WATER RESOURCE

The impact of the Agrosilvopastural system on water quality is dependent on the volume of water produced as a by-product from the coffee process, the volumes of pesticides used to maintain the fitosanitary control of the area, given their levels of toxicity. The following table shows the impact the system has on the quality of water:

Table 34 Project Activity Impact on Water

IMPACT	AFFEC-TED RESOUR-CE	TYPE	IMPOR-TANCE	DURA-TION	MITIGA-TION	ORIGIN	MANAGE-MENT
Effect on water quality due to possible intake of organic matter and pesticides in the run off of the system.	WATER	NEGATI VE	LOW	Cyclic, Only During Applicati ons Of The Product	Possible	Escape of organic charged water from coffee processing y decomposition of vegetal material from sanitary control of the System	Assessment of Point sources of water contaminati on

Even though the objective of the plan is organic agriculture, it is probable that there will be a need for agricultural inputs and pesticides in coffee, beans, corn, vegetables, "achiras" and garlic, generating liquid and solid waste from the manure and the coffee depulping, which affect the physical and chemical quality of the water.

5.5 BIOLOGICAL IMPACTS

The impacts from the project on both flora and fauna, land and water, are low. On the other hand, cattle grazing above 2,000 mosl. is an issue that could affect the stability of the soil, given the steep inclinations of the hills; moreover, the impact is increased if it were to reach the buffer zone of the Natural Park of Las Hermosas. The following table shows the summary of potential biological impacts.

Table 35 Qualification of impacts of the Agrosilvopastural system on the Biota

IMPACT	AFFECTED RESOURCE	TYPE	IMPORTANCE	DURATION	MITIGATION	ACTION PRODUCING IT	TYPE OF MANAGEMENT
Enlarging of the agricultural frontier with damage to the native vegetation in the buffer zone of a natural park	Vegetation	Adverse	Moderate	Permanent	Prevention and Control	All the Project	Environmental education and training of professional park rangers from the community in the area
Effects on aquatic flora with polluted waters from coffee processing and pesticides from the run off.	Vegetation	Adverse	Low	Permanent During the project	Possible	Coffee processing	Environmental optimization of coffee processing and integral handling of chemicals (biologic pesticides)
Possible increase in hunting of mammals	Fauna	Adverse	Low	Permanent	Possible	The Project	Environmental education and training of professional park rangers from the community in the area
Effect on aquatic fauna by pesticides	Fauna	Adverse	Low	Permanent	Compensate	Sanitary control	Environmental optimization of coffee processing and integral handling of chemicals (biologic pesticides
Risk of contamination for workers with pesticides	Man	Adverse	Low	cyclic	Education	Sanitary control	Education on professional risks caused pesticides

The following table presents a summary of all the environmental qualification values and alterations, individually for each of the resources identified for the project. In order to determine the environmental qualification for each one of the resources, an arithmetic mean of the CA values obtained was produced.

Table 36 Summary of Values of Environmental Quality Obtained for the Different Resources

RESOURCE	VALUE OF EC	ENVIRONMENTAL ALTERATION (EA)
Air	-1.2	**Low**
Water	-3.2	**Médium Low**
Soil	-3.4	**Médium Low**
Flora	-2.2	**Low**
Fauna	-1.8	**Low**
Social	+3.0	**Low**

As can be inferred from the EC averages reported in each of the identified impacts, the resource that presents the most adverse environmental alteration (EA), is soil (-3.4), mostly because of scour in gullies or drains adjacent to cultivated fields and contamination of the soil, due to poor disposition of solid waste from corrals and sheds; for this reason, the Environmental Management Plan addresses this problem in Forms No. 1, "Cultural Practices", Form No. 5, "Management of corrals and sheds" and Form No. 9, "Conservation of soils due to poor Disposition of Solid Waste". Each indicative measure, along with the procedures to attain the measure, as presented in every form included in the Environmental Assessment.

In descending order, the next largest affectation is on water resources, (-3.2). The activities that compromise the water quality's alteration are drainage, the susceptibility of the terrain hence erosion may occur, the steep slopes may facilitate landslides, contamination with sediments coming from land alteration, as well as the use of agrochemicals. To counteract these environmental effects, the EMP proposes Forms No. 1, "Cultural Practices"; No. 2, "Agronomic Practices" and No. 8, "Water quality control".

In regard to Flora and Fauna (-2.2 and –1.80), the greatest affectation comes from possible impacts on valuable animal and vegetation species in the buffer zones of the Las Hermosas natural park. In order to control these potential shocks, the EMP implements Forms No. 1 "Cultural Practices"; No. 11 "Management of Vegetative Cover with areas of floristic compensation complemented with activities of the SMP, No. 16, Environmental Education" and No. 21, "Forest Rangers".

In regards to air (-1.2), the greatest affectation comes from odor emissions from corrals and sheds during the operating phase of the project. This impact is controlled by Form No. 5 "Management of corrals and sheds".

Other potential alterations to the environmental quality of the area are considered in the full formulation of the EMP, in chapters to come, in order to obtain an integral management plan.

The beneficial alteration of the project is mostly on the socioeconomic front, where most of the positive EC values were found. The EC average was +3.0, corresponding to a medium low environmental alteration. In order to supplement these benefic aspects of the project in the social environment, the EMP proposes Forms No. 15, "Support Infrastructure"; No. 16, "Environmental Education", No. 17, "Technical Formation", No. 18, "Watershed Management",; No. 19, " Training of Leaders"; No. 20, "Security for Alimentation" and No. 21, "Forest Rangers".

When the mean values of environmental quality are independently calculated for negative and positive effects, and these values are then added arithmetically, one can estimate the average environmental alteration produced by the project as a whole: it is a of a positive nature.

Finally, it can be said that the environmental assessment of the different phases that conform the Multipurpose Anamichú Project show that, although some of these activities are producing impacts on the environment, the affectation can be diminished with the implementation of the EMP, which includes all the measures required to counter these effects and increase the social benefits produced. In this way, it is expected that the Environmental Quality will improve with the implementation of the EMP, with a corresponding increase in social benefits from the community's attitude towards the environment and the project.

In the next chapter the Consultants present the selected measures chosen to prevent, control, mitigate, correct or compensate the effects that the Agrosilvopastural project might produce on the environment of the watershed of the Anamichú River canyon.

5.6 ENVIRONMENTAL MANAGEMENT PLAN

5.6.1 Overview

Although the adverse impacts or affectations generated by the development of the Agrosilvopastural Project in the canyon of the Anamichú river – Department of Tolima, do not have the dimensions that it would have in an ecosystem untouched by man, this portion of the report shows the actions and mechanisms to control, mitigate, prevent, correct or compensate the impacts that the project might have on the environment.

The environmental management recommendations can be preventive (to avoid the impact from happening), corrective (measures that will modify the acting vector to prevent its impact in the future), mitigating or amelioration of the impact, or compensation when the impact is impossible to prevent, correct or mitigate and needs to be healed.

5.6.2 Methodology

Each program or mitigating measure contains specific factors that can generate environmental effects, its mitigating measures and the needed strategies to monitor the activities to follow. In general, each measure has the following content :

- **Type of Measure**

Establishes the nature of the mitigating measure insofar as prevention, mitigation or compensation is concerned, depending on the magnitude of the impact.

- **Objectives**

Defines the final goal pursued by the measure, to be expected from the execution of the program.

- **Impacts to Control**

Consists of an enumeration of the different impacts and/or environmental effects that have to be mitigated when the measures are executed.

- **Spatial Coverage or localization**

Defines the space where the measure or program is to be applied.

- **Designs**

Contains the technical considerations and designs over which the measure is conceived.

- **Description**

Corresponds to the description of the actions to be carried out in each of the activities for purposes of diminish, mitigate or keep the predicted effects from happening.

- **Schedule**

Indicates the moment when the proper measures are to be implemented.

- **Costs**

Those generated by the utilization of resources necessary for the implementation of the measure.

In order to be consequential with the identification and Assessment of impacts and measures, the latter have been grouped according to the environmental component they affect. The following table summarizes all the measures established for the Environmental Management Plan to be executed for the Project.

Table 37. Environmental Measures to be applied to the Agrosilvopastural Project

PROGRAM	FORM No.	MEASURE
SOIL MANAGEMENT	1	CULTURAL PRACTICES
	2	AGRONOMIC PRACTICES
	3	PESTICIDE AND WEED CONTROL AND MANAGEMENT
	4	WEED CONTROL
	5	EROSION CONTROL
	6	SOIL CONSERVATION BY SOLID WASTE DISPOSAL
	7	CLEAN TECHNOLOGIES FOR SOIL PREPARATION AND MANAGEMENT OF CHEMICALS
WATER RESOURCES MANAGEMENT	8	WATER QUALITY CONTROL
	9	MANAGEMENT OF SHEDS AND CORRALS
MANAGEMENT AND CONTROL OF FLORA AND FAUNA	10	PROTECTION AND REGULATION OF VEGETAL MATERIAL CONSUMPTION
	11	VEGETATIVE COVER MANAGEMENT BY FLORISTIC COMPENSATION
	12	GENERATION OF LIVE FENCES AND PLANTATION OF VEGETATIVE COVER
	13	FAUNA MIGRATION CONTROL
ECOSYSTEM PROTECTION	14	CONSERVATION OF NATIVE ECOSYSTEMS
	15	ORGANIC AND BIOLOGICAL AGRICULTURAL PRACTICES
SOCIAL MANAGEMENT	16	ENVIRONMENTAL EDUCATION
	17	TRAINING AND TECHNICAL ASSISTANCE
	18	PARK RANGERS
	19	SUPPORT INFRASTRUCTURE
	20	ORDERING OF THE ANAMICHU WATERSHED
	21	TRAINING OF LEADERS
	22	FOOD SAFETY

5.7 RESULTS

The matrix shows that the management of solid residues is the activity that generates the most impacts on the physical environment, and since these impacts are also the ones with greater magnitude, plus farming will be carried out on high and steep slopes, the Environmental Management Plan has the following specific objectives to control this potential severe negative impact:

- Train the community involved in the project soil and water conservation techniques, as well as correct management procedures for solid waste reduction and correct disposal (e.g. pulp from coffee, and *gallinaza* from chicken manure).

- Teach the community involved in the project, last generation techniques regarding fertilizers, organic pest control management procedures, which besides doing their purpose in controlling pests and plant sicknesses, are harmless to the ecosystems, in accordance with the aims of the project.

- Teach the community involved in the project, technologies of "minimum labor" of the soil and the implementation of organic agriculture for the sustainable utilization of natural resources.

5.8 PHYSICAL ASPECTS

First, it is imperative to make the best technical effort to obtain clean agricultural production, especially in the coffee processing streamline; likewise, develop pest control through biological management.

On another front, and once efforts have been made to control contamination at the source, a program must be developed to permanently evaluate water quality according to the following steps:

- Obtain a list of sites where there are contamination points (i.e. processing plants, stables, solid waste accumulation, waste water sources, etc.).
- Quantify direct or indirect contribution of contaminants to the water, (input/day, month, etc).
- Determine the vicinity of the closest sources of river contamination, and the distance from these to the Anamichú River.
- Measure the parameters BOD y QOD, at the sites where it is proven that contamination arrives.
- Measure the quality of water at the Anamichú river below Gaitán (measuring point in this study), to compare the state of the water in regards to the evolution of the Agrosilvopastural project.

5.9 BIOTIC ASPECTS

Recommendations for both vegetation and fauna controls must be taken into account, because these could be preventive to avoid the impact, and corrective, recommending measures to deter it from happening in the future.

Among the best preventive measures are environmental education and the formation of professional park rangers within the community.

Among the corrective measures, the most important is the integrated control of pests utilizing technology of low toxicity (IPM) and the environmental optimization of the coffee processing procedures.

Each one of these measures was detailed in a series of Forms, that have not been translated into English, because of their length, but also because they will be mainly used to divulge these within the community, so they can appropriate themselves of the tasks ahead and begin a new and refreshed environmentally sound future.

5.10 SOCIAL ASPECTS

The main problem addressed by the Consultants in the social realm was the fact that an important part of the community is settled near or in the buffer zone of the National Natural Park of Las Hermosas. The preservation of the national heritage with its sources of water, flora and fauna, provides a guideline to the magnitude of the restrictions that need be imposed.

In order to establish an equilibrium between the allowable anthropic load permitted above the 2,000 mosl altitude, perhaps a resettlement process for some families, under the criteria of real improvement of living conditions, might be an adequate management measure in the medium term planning. This alternative not only consults the importance of the buffer zone, but also limits the possibility of new sources of migration and environmental impact.

The families incorporated to the program, especially in the buffer zones, must be subject to environmental formation and education under a scheme of participation, within a research program of an interdisciplinary group of specialists (sociologist, biologist, forestry engineer, agronomist etc). This formation procedure assures knowledge/technology transfer in a direct and practical way, as well as the recognition of ancestral cultural practices; it can also help direct ecoturism and forest keeping, when the socio-political conditions allow.

From a different point of view, the identification of sociocultural and economic impacts on the natural environment introduces the determination of practical and strategic needs both of the families in the program and the regional community at the national and international levels. Preservation of natural protected areas and the concomitant environmental services these provide, establish a condition which goes beyond the local perspective and establishes the dichotomy between poverty and the environment; the local and the regional; the national and the international arenas.

The main preoccupations of these communities are a dignified survival, as well as the collective vision of a peaceful life with the fulfillment of basic needs and the increase of income levels up to more reasonable standards.

As was mentioned before, the program's reach cannot be limited to the local realm. It is imperative to begin ordering the watershed that identifies the different environmental and social components of the project, and the different categories of the population involved.

It is also an objective to sustain the process of reverting the illicit crops to legal and improving the socio-political environment. An absolute priority is then to improve the cultural characteristics and the quality of education at all levels of the community, opening alternatives of active participation for young people.

5.11 ENVIRONMENTAL MONITORING AND FOLLOW UP PLAN

Overview

The Environmental Monitoring and Follow-up Plan (EMFP) is part of the Environmental Management Plan –EMP- and constitutes a tool in which the detailed programs, from the activity of impact identification, are consigned, to allow verification, vigilance and Assessment of the actions and activities of the project before, after and during its execution.

The environmental monitoring and follow up program will also have as an objective to obtain the environmental information necessary to determine and describe the behavior of the plantations; to provide elements of judgment and ease the decision-making process on a more predictable basis; it will also serve to minimize the adverse character of environmental effects and guarantee the technical soundness of the analysis and solution of eventual conflicts between peasants, the operator of the project and the environmental control authority with respect to the interpretation of environmental topics related to the several crops.

5.12 GENERAL OBJECTIVE

The general objective of the EMFP, is to provide the Environmental Authority, the Community, the Chemonics Foundation and USAID, with a technical basis for verifying the correct development of the project.

5.13 SPECIFIC OBJECTIVES

The EMFP will establish the necessary activities to implement the EMP and the responsibilities that are required for verification, vigilance and Assessment of the activities of the Plan.

The Plan will establish in a detailed manner, the indicators and the places where the monitoring should take place, as well as the methodologies recommended in particular for sampling and verification, including periodicity of sampling, duration, type of analysis, forms of Assessment, costs and financing of the activities. The sampling points will be established taking as a basis those that were used for the Environmental Assessment in the EIA, in order to increase the confidence of the results and run comparative Assessments.

The Plan will include recommendations regarding the form for presenting periodic reports, with argumentation of the periodicity of reporting, and will establish the extent of advances on the following aspects :

- Physical and Chemical Monitoring on Intervened Water Bodies
- Reforestation and Erosion Control programs
- Biological Control programs
- Solid Residue Management programs
- Social Welfare Management programs

The present report presents the Chemonics Foundation, USAID and the Environmental Authority, a proposal for implementation of an EMP and an EMFP, considering these aspects :

- Environmental Components to Monitor
- Location
- Impacts to Monitor
- Scheduling of Check ups
- Types of Monitoring Measures
- Frequency of Monitoring Activities
- Costs
- Responsible Persons

5.14 SUMMARY OF ACTIVITIES

For the purpose of construing the Monitoring and Follow up Plan as a project activity of easy execution and verification by the Environmental Authority and the USAID, it has been determined to present it as a chart that includes all aspects of the Project that will have to be controlled and followed upon, as referred to each one of the activities proposed in the EMP.

5.15 COSTS

Costs for the EMFP have been estimated according to the methodology proposed in the Forms of the EMP; this means that the EMFP induces costs for each one of the activities of the EMP. It is to be noted, that the personnel in charge of the activities of Monitoring and follow-up, corresponds to the same personnel referred to in the EMP, which conforms the Environmental Management Group, described later in this report; for this reason, the costs of the EMFP are only related to the costs required for the sampling and the laboratory analysis of water and soil quality, the direct costs of photographic records and the elaboration of reports.

The Forms for Monitoring and follow up activities are shown in Appendix 1, and can be modified according with the particular conditions at each location and with the peculiarities of each one of the indicators to measure.

5.16 CHRONOGRAMS

In order to demonstrate the parallel behavior in the execution of the activities of the EMP and the EMFP, a bar diagram of the Gant type has been designed, indicating the time for each measure, and the corresponding activity of monitoring, follow-up or Assessment that is needed. Figure 7.2 shows the chronograms for both plans for a typical year in the project.

5.17 ENVIRONMENTAL LEADERSHIP PLAN

Environmental Policy is a group of basic rules that have to be taken into account during the formulation and the execution of the project, in order to obtain that it fulfills adequately the purposes of conservation of the natural environment, the efficient recovery of the resources, the augmentation of the productivity and the fulfillment of the environmental norms. Environmental policy has been designed taking into account the results of the environmental Assessment, from which it draws the basic information.

System for Environmental Leadership

The system for environmental leadership is supported by the principles of compromise and internal conviction that permit to make an auto Assessment and to improve in an objective manner the different phases of the project, in order to empower the positive actions and minimize the negative actions which can have a significant influence in the deterioration of the environment.

Good environmental management do not just serves to implement the measures of the EMP, but serves also as a tool to optimize the resources used, allowing the cultivator to be more competitive and to be able to contribute better towards the sustainability of the project.

In this order of ideas, to obtain the maximum benefit it is necessary that producers understand the importance of environmental management and develop the actions and programs of the EMP inside their organizations at the level of farm, communal land or association so that the people working there give adequate treatment to the natural resources that are in danger of being negatively affected by the project.

It is fundamental to take into account that in order to minimize the negative environmental impacts, the producer/farmer must use clean technology, besides improving his productive processes, according to his possibilities in order to gradually come to comply with the requisites stipulated in the environmental ruling.

The implementation and development phase of the EMP, corresponds to the application of the environmental measures and the productive processes that can be implemented as a part of a proposal for sustainable development. In order to accomplish the execution of these measures, it will be necessary to take into the account the following :

- To create an organization structure that permits the creation of positions for director, coordinator and executor of the system of environmental management, and the people to fill the positions.
- To assign resources, establish procedures, create communication networks and operational controls.
- Provide the system with the human resources, the physical resources and the financial means to obtain the proposed benefits.
- To support the provision of resources, based on the activities and requirements of personnel, materials, equipments, and other inputs.

The phase of follow-up corresponds to the verification of the effectively and efficiency of the environmental measures executed, supported by the following actions :

- Measure and monitor the characteristics of the operations and activities that cause environmental impacts.
- Define responsibilities and authority to manage, investigate and correct the inconformities.
- Maintain the environmental records needed to corroborate the fulfillment of the proposed objectives and goals.
- Perform periodically environmental audits to determine if the management system has been correctly implemented and maintained according to plan.

5.18 ENVIRONMENTAL MANAGEMENT GROUP

In order to implement the Environmental Management Plan for the Anamichú project in the Department of Tolima, it has been considered pertinent the conformation of a group of environmental leadership, in charge of supervising that the measures for implementation of the EMP are executed in accordance with the recommendations of this study.

SECTION 6 LIST OF PREPARERS

The work group for the present project consisted of the following professionals:

- RAQUEL DUQUE R. Civil Ing., M. Sc. en Environmental Engineering and Water Resources. Coordinator of the Study.

- PATRICIA ALAMEDA, Sociologist, In charge of socioeconomic aspects of the project.

- RICARDO CAICEDO Ing. Agronomist. In charge of technical aspects of the project, soil utilization, soil production, etc.

- GERMAN CAMACHO, Biologist. In charge of biological aspects of the project, (flora, fauna), water quality and of the formulation of environmental management alternatives.

- PIEDAD CONSTANZA MORA. Sanitary and Environmental Engineer. Field engineer in charge of the characterization of the physical baseline and the formulation of management ideas.

For water quality tests, the consultants used the laboratories of DAPHNIA Ltd., of Bogotá, a recognized center with equipment and personnel well versed in the required analysis.

SECTION 7 APPENDIX

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