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Estimation and Evaluation of plants as indicators of tropical soil quality from the knowledge of the peasants, Cauca Colombia

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Foreword

In order to develop „sustainable systems of land use“ in the tropics, the indigenous or local knowledge is being more and more considered for the recording and evaluation of soil ressources. For developing projects, for example, it is assumed that technological support can be provided in a better and more effective way when participation, perception and local knowledge - concerning autochthonous adapted systems of land use and soil quality- are taken into account. Nevertheless, the application and scientific utilization of local knowledge about soils and its classifications has been scarcely developed, compared to ethnological and pedological methods of analysis. Thus, the term „participatory investigation“ often merely describes local knowledge.

Considering the farmers‘ knowledge about „management of land use“, as well as empirical experience of cultivation, in this study it is tried to relate the local knowledge to the soil fertility parameters. In the course of this ethnopedological approach, it is attempted to derive plants indicating of soil quality.

The field study was carried out in the watershed of the Cabuyal River, in the department Cauca, Colombia. On the basis of a long-standing soil data bank of the Secretary of Agriculture and the CIAT, the temporal development (since 1970), as well as the correlation of chemical soil parameters with the local plant indicators could be well derived. Indicating plants for "good" and "bad" soils of different fertility correlate significantly with classical parameters of soil fertility. Furthermore, it becomes evident that the local soil classification is defined according to soil parameters as well as to cultural parameters of use.

This dissertation shows how local knowledge about soils can be integrated into an evaluation of soil fertility and the planning of soil use, in a time-saving way. We hope that these insights will also be applied by agencies of development and NGOs for rural developing projects.

Gerhard Gerold Göttingen, December 19 2004

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Abbreviations

Al	Aluminium
C	Carbon
Ca	Calcium
Cm	Centimetre
CECe	Effective Cation Exchange Capacity
Ct	Carbon total
CIPASLA	Consorcio Interinstitucional de Agricultura Sostenible
FAO	Food and Agriculture Organization
f.e.	For example
FCC	Fertility Capability Soil Classification System
H_2O	Water
IGAC	Instituto Geográfico Agustin Codazzi
ICS	Quality Indicator Soil
ISSS	International Soil Science Society
K	Potassium
Kg	Kilogram
m	Metre
m^2	Cuadrat Metre
MO	Matter organic
Mg	Magnesium
N	Nitrogen
NGO	non-governmental organization
OC	Organic Carbon
P	Phosphorus
ppm	Parts per million
S	Sulfur
SOM	Soil Organic Matter
SQI	Soil Quality Institut
SQ	Quality Soil
UNEP	United Nations Environment Program
USDA	United States Department of Agriculture
%	Percent

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1 Introduction

La ciencia se debate hoy entre dos políticas alternativas. Por una parte, seguir siendo la principal herramienta de la economía mundial de mercado orientada por la búsqueda de la ganancia individual y el crecimiento sostenible. Por otra parte, está llamada a producir conocimientos y tecnologías que promuevan la calidad ambiental, el manejo sustentable de los recursos naturales y el bienestar de los pueblos. Para ello será necesario conjugar las aportaciones racionales del conocimiento científico con las reflexiones morales de la tradición humanística abriendo la posibilidad de un nuevo conocimiento donde puedan convivir la razón y la pasión, lo objetivo y lo subjetivo, la verdad y lo bueno. (Leff E.)

The present study of investigation is a contribution to the sustainable handling of soils, from a perspective of interdiscipline between the natural sciences (agriculture, geography, edafology) and the social sciences (sociology, anthropology). The new paradigm of the investigation proceeds from the „*dialogue of knowledge*" as a basis. Thus the scientific and local peasants` knowledge are integrated in this investigation. The latter are the ones who work daily and who elaborate certain concepts, classifications, who use and handle the soil according to their social and historical conditions (Talawar, 1996, Doran, 1990). The soils themselves are the basis of our existence. It is necessary to generate conscience about the need to protect the superior layer of the soil, and this is not only the peasant's responsibility, but one of the whole society in general (State, Universities, NGO's). According to estimations made by the UNEP, every year between 5 and 7 million hectares of soil are lost worldwide, due to soil degradation (FAO, 1996). The contemporary vision points out the soil as dynamic resource, vivid and vital for the production of food, fibre for the global balance, and the function of the ecosystem to sustain life on earth. That is why the quality and health of the soils determine the sustainable agriculture, and despite the capacity of resistance, the soil is finite.

That is why it must be protected and studied as a system which integrates progresses, their dynamics and biological, physical and chemical properties (Feijoo, 1999).

At world level, working on soil quality (ICS), with the agriculturists' help, is a topic which is just starting out and of great importance to propose methods that contribute to the determination of soil quality in a simple, effective and clear way. The indicators of quality and/or fertility of soils should stick to environmental criteria, and the scientists should create politics according to socioeconomic and ecological situations. The prevailing criterion should be the sustainability. (Doran and Safley, 1997).

The present investigation puts emphasis in the local knowledge by the peasants, as a fundamental tool for the soil's sustainability and development. (Winkler Prins and Rhoades 1994 Cited by Rivas). The study has been developed in the watershed of the Río Cabuyal in the department of Cauca, Colombia, where different governmental institutions and independent organizations have been working for more than 30 years. These are the following: Secretaría de Agricultura, Federación Nacional de Cafeteros, Centro Internacional de Agricultura Tropical, ASPROME, CETEC, etc). The majority of these institutions have joined in the Interinstitutional Consortium for Sustainable Agriculture, CIPASLA, who have been pioneers in projects of development and environment protection. Within these projects, the fundamental aim has been to strengthen processes of participation. CIPASLA contributed a lot in the present investigation, with technical and logistic support for the realization of field work during about 10 months of living with the peasants of this watershed.

1.1 Hypothesis and objectives

Initially, the hypothesis, taken into account for the present investigation, are the following:

> "In the oral culture of the peasants, the presence and maintainment of some plants of the wild vegetation serves as indictor for the fertility of soils which are used to esteem the soil's quality."

> "Tools of the technical-scientific culture can be used to attribute physical, chemical and biological properties of the soil to indicating plants."

> “ If a system of knowledge between these two islands could be established, we could dispose of use thesse knowledge as indicators of soil degradation.”

The general objective of this investigation was: to determine the peasants’ knowledge about quality and fertility of soils, with the priority of the weeds as a peasant’s indicator of soil quality.

And as specific objectives:

- To evaluate and determine the behaviour of the soil’s chemical parameters in the watershed during the last thirty years. Also to evaluate and determine the soil’s present state, judging by the soil’s analyses of the secretary of agriculture.
- To determine the local system of evaluation of the soil’s quality and the principal local indicators of the watershed’s soils.
- To differentiate plants which according to local knowledge are indicators of soil quality. To elaborate a toposecuence in the watershed, from the high to the low zone, with the aim of correlating the properties of indicating plants to soil quality.
- To establish a system of correspondence between the two sources of knowledge, the scientific and the local one, to dispose of early indicators of soil quality.
- To regain the agriculturists´ knowledge which procedes from their apprehension and relation with the soil.

Methodologically the research required a stay in the watershed for ten months, for the recollection of field data: The gathering of information concerning the agriculturists´ knowledge, through direct interviews, a survey with 47 rural families and workshops on soil quality. Together with the agriculturists, soil samples were taken from each of their lots, besides visiting the lots to recollect the principal indicating plants (weeds), according to the agriculturists.

1.2. Present state of the Problem

Since 1920, waves of emigrants have begun to turn the mountain forests into property, grass land region and arable soil (Molano, 1992 Cited by Feijoo, 1999), and after 1940, when extending the industrial systems of culture by valleys, the cattle ranch moved towards slopes of Andean mountain ranges, characterized by the high diversity, generating structure of production characterized by the agriculture of the peasantry and extensive systems of young bovines.

The present panorama has not changed; many municipalities suffer from the deterioration of the hydrographic river basins and the deficiency or excess of rainwater that facilitates in this case the natural disasters caused by the hydric erosion. That is why the infiltration has diminished in such a way that during rain periods, in some localities run-off takes place and just a short time after the rains (4-6 days) the symptoms of water deficiency are distinguished (Amézquita and Londoño, 1997).

1.2.1. Impact of the soil in the area of Investigation

The points of departure are the main cultural practices in the climatic conditions of the region. The increase of acidity with the application of acid fertilizers can be appreciated, as well as the loss of cations by leaching and erosion. The increase of acidity, on the other hand, generates the increase of the solubility of aluminum within the soil (considering that the contents of aluminum of volcanic soils are relatively high.) The increase of soluble aluminum, on the other hand, causes an increase of the soil's acidity, reduces the disposal of nutrients and the efficiency of the fertilization, especially of phosphorus.

The investigation of such diversity in Andean mountains makes a possible strategy of investigation at the landscape level difficult to realize; for such reasons it has been preferred to work with the concept of hydrographic river basin, which is defined as complex hierarchic systems, dynamic and of adaptations in which the natural processes and the human activities take place (Knapp et al, 2000). The plan of handling of a hydrographic river basin must be based on a series of technical studies, amongst which the one of soils ranks as well. The aim is to establish precise norms and to obtain the benefits that guarantee the conservation, the sustainability of the production systems and recovery of the natural balance, as well as to create a global knowledge to generate data bases of fragile resources of the soil. These must be related to the environmental parameters that affect the agroecosystems. Furthermore, this plan is important to stimulate the development of programs or technical itineraries that involve the participation with decision-making character of the communities of agriculturists and their families in the local and regional scope.

Although the study of soil was only a small part of the ethnoscientists larger research agenda, their probing of informants elicited a substantial amount of information on soil -crop and soil-vegetation relationships. Weinstock (1984), as an example, has categorized studies on local soil classification into two groups: studies dealing with the most readily observable physical dimensions of soil (such as texture or color) and those local classification studies based on cultural dimensions. An example of the latter is the symbolic classification into "hot" and "cold", based on the fertility rather than the actually subsurface temperature of a soil. Many such works also concentrated on how local knowledge of land and soil was used in locating shifting cultivation plots based upon indicators like vegetation and morphological features.

Finally, in the era of the summit of Río (1992), concerning the interest in knowledge and local soil handling, the studies have been oriented towards the "utilitarian thing"; that means, while using the local soil knowledge guiding the development of sustainable soil use (Winkler & Prins, und Rhoades, 1994). The assumption that is underneath these studies is that the more appropriate and political technical assistance can be developed with the understanding of how the local populations perceive and use their soils.

In this sense, there have been several attempts to show externally "to the scientist" that categorizations of soil are not locally understandable. The local and scientific classifications contrast, nevertheless, do not answer the question of how the local systems of the classification relate to the real address and earth operation. The studies of local soil classification are - historically and ethnographically based - typically ahead the "cognoscitivo" approaches, while the investigation of earth direction really focuses in the archives of "carried out daily practices" by peasants. Although the systems of soil classification sometimes reflect that the territories of the way are management, while understanding classification only, does not make that necessary and explains or defines the real use. Therefore, a greater challenge is to combine these two aspects. The knowledge and conduct in a more significant ethnopedological context. Before approaching this synthesis, it is necessary to review what we presently know separately on the "cognoscitivos" aspects and behavior.

In the Colombian Andean zone, agriculture is practiced by producers of limited resources, in property located in slopes with pending forts, characterized by rich acid soils in alofans, with high capacity of phosphorus fixation and prone to severe erosion (Ashby, 1985; Reinning, 1992). The erosive Andean slope atmosphere processes limit the growth of the plants and, with it, the possibilities of sustaining an increasing human population in the region. The high potential erosion of these soils can be attributed more to the high erosive power of the rain (high intensity, with hail in some occasions) than to the erodability of the soil (Rupenthal *et al*., 1996).

In slopes of the North region of the department of the Cauca, the erosion process has led to the almost complete loss of the volcanic ash layer that covered the area before (Suarez, 1982, mentioned by Müller, 1998). The soils of fishermen, in the north of the Department of the Cauca, are characterized as being not adequate for the agriculture technified by its pending forts and high degree of erosion; in addition to its chemical conditions they are little favorable, being extremely acid soils with very low phosphorus contents (Cadavid and Howeler, 1984). The soils of the shown plots for this test have characteristics that seem to agree with the typical ones of the region. That means, in general an acid pH between 4.5 and 5.5 in average) and a poor fertility, with a very low calcium and magnesium content, slightly low content of potassium, a high percentage of aluminum saturation and organic matter and low capacity to retain nutrients (Buitrago, 1999). In general most of these soils present different degrees from degradation and constitute the present basis of the farming activities (Müller, 1992).

2 State of knowledge and ethnopedology

La integración del ser humano con la Naturaleza supone una armonización con ella, capaz de compasión, porque la tierra no está fuera de nosotros, sino dentro de cada uno, como la Gran Madre. Al agredir a la Naturaleza estamos agrediendo arquetipos de nosotros mismos Por eso todo opresor se reprime a si mismo. Para oprimir al otro, pera reducir al otro a la condión de cosa, tiene que recalcar en sí mismo la dimensión de humanidad.(Boff L.)

2.1 Global function of the soil and sustainability of soil

The climatic change, the destruction of the ozone layer, the destruction of biodiversity, and the degradation and loss of the soil's productivity, are related to our consume patrons, the technology that is used, and to the increase of the world's population. Increasing worldwide concern for sustainable global development and preservation of our soil resources is reflected by numerous recent international conferences such as the United Nations for Environment and Development (UNCED) in Rio de Janeiro, Brasil (1992); The conference of sustainable use of soil in Budapest 1992; the conference of sustainable application in Lethbridge, Canada, 1993; and the International Congress of Science of the soil in Acapulco, México, 1994. The central discussion on these conferences concerned the menace for the sustainability, as a consequence of the environment's and soil's degradation. The reasons for this are the increasing population and life standards (Doran, 1996).

After the Second World War, the agricultural production of some countries has increased three times, due to the implementation of an agricultural model based on industrialized and chemical methods, which require energetically resources. This has been questioned by ecologists, soil scientists and by the church (Jackson y Piper, 1989; Sagan, 1992; Bhagat, 1990).

Interest in evaluating the quality and health of our soil resources has been stimulated by increasing awareness that soil is a critically important component of the earth's biosphere, functioning not only in the production of food and fiber but also in the maintenance of local, regional and global environmental quality (Glanz, 1995).

The loss of organic matter in the soil, erosion, contamination of superficial and subterranean water in the United States, have been increasing in some cases due to the methods employed by the industrialized agriculture (Gliessman,1994; Hallberg, 1987).

Recent publications testify the severe degradation of 10% of plowable soils through erosion, atmospherical pollution, clean cultures, salinization and desertification (Sanders, 1992). The program for the environment of the United Nations „Global evaluation of the soil degradation“, estimates that 40% of the degraded soils are induced by men.

The irrational methods of soil handling deteriorate the atmospherical quality, as it is within the soil where atmospherical gases, such as carbondioxid, nitric oxides and methane (CAST, 1992; Rolston et al.; 1993 Cited by Doran) are exchanged. The danger of climatic change and levels of atmospherically gases and alterations of hydrologic cycles, forces to improve the comprehension of the soil's handling and its processes. (Doran, 1996).

2.2 Necessity of the Soil Conservation

The soils are the basis itself of our existence. Through past, presence and predictible future, they have been, still are and will be the basis of our chain of nutrients' supply and a vital, capital resource of each nation.

Everybody should be completely conscious about the fact that the soil's layer, which serves as support for human life, is very delicate and that the formation of soil is a slow process. Once the superior layer is lost, due to erosion, it is very difficult to restore it. Damages which are invisible at first sight, can affect the productivity in a serious way. The soils are much more vulnerable than it is usually thought. Only if they are handled appropriately, they can be considered renewable resources.

In the humid tropics, where most of the developing countries are situated and where the individual exploitations are usually small, the danger of soil erosion is high, due to the frequent and intense rain. When they are subject to exploitation and unsuitable cultures, the soils of these zones can be eroded strongly and in short time. The necessity of careful soil conservation in these zones is fundamental. (FAO, 1990).

A detailed study, financed by the Rockefeller Foundation (Possner & McPherson, 1981), has illustrated the importance of the mountain soils for the national economics of many countries of Tropical America. The study shows that these soils cover between 45% and 80% of those countries, and that they are the support of 20 to 65% of the farming population. Despite its importance for the national economics, the soils of slope and mountain of the humid tropics are used frequently in an improper way. Concerning development and protection, they get much less national and international attention than they should. The whole problem is frequently left to the peasant.

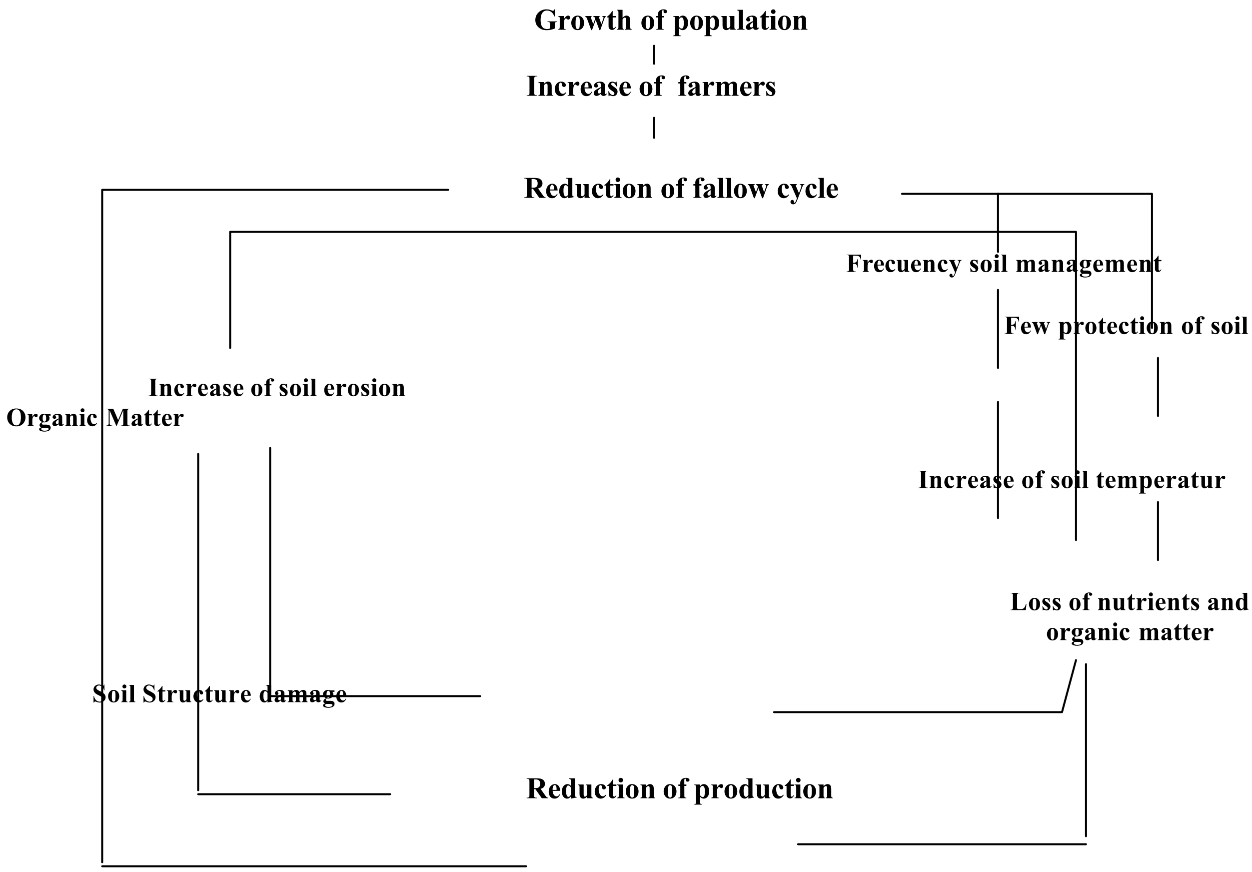


Figure 1: Cycle of degradation and soil erosion (König, 1995)

2.3 Health and Quality of Soils

The contemporary vision emphasizes the soil as dynamic, living, vital resource for the production of food, fibres for the global balance and the function of the ecosystem to sustain life on earth. Therefore the quality and health of soils determine sustainable agriculture, and in spite of the resilience capacity, the ground is finite and for that reason it must be protected and studied as a system which conjugates progresses, it is dynamics, biological, physical and chemical properties. (Feijoo, 1999).

In former times the soil was considered a deposit of fertilizers and insecticides and it was only taken into account as a generating source of income rate, therefore the vision was reduccionistic and with productivity interest. Nowadays, the soil has meaning, not only for production, but also for sustainability. Thus the ground, a vital, living and finite resource, is being glanced at in a different way (Doran et al., 1996). This is how the concept of soil quality is introduced and defined, in agreement with attributes of the same such as erodability and compatibility. Later on, it was extended to include attributes of nourishing security, quality, human, animal and environmental health (Parr, *et al.,* 1992). Also, Blum and Santelises (1994) describe a concept of sustainability and soil resilience based on six functions: three ecological functions and three which are linked to human activity. Ecological functions include biomass production (foods, fibers and energy); the soil as reactor which filters, buffers, and transforms matter to protect the environment, groundwater, and food chain from pollution; and soil as biological habitat and genetic reserve of plants animals, and organisms, which are protected from extinction; Functions linked to human activity include the soil as physical medium, serving as a spatial base for technical and industrial structures and socioeconomic activities, such as housing industrial development, transportation systems, recreation, and refuse deposal; soil as source of raw materials supplying water, clay, sands, gravel and minerals, etc.; cultural inheritance, that contains palaeontological and archaeological treasures, important to preserving the history of the earth and the humankind. (Doran, 1995).

The terms "soil quality" and "soil health" are often used interchangeably in the scientific literature and popular press. The scientists, in general, prefer "soil quality" and producers prefer "soil health" (Harris and Bezdicek, 1994). Some prefer the term "soil health" because it portrays soil as a living, dynamic organism that functions holistically rather than as an inanimate mixture of sand, silt, and clay. Others prefer the term "soil quality" to describe its innate quantifiable physical, chemical, and biological characteristics.

Doran (1999) defines quality and health of the soil as synonymous. First, health, derivative of the experiences -local knowledge- and descriptive understanding of the surroundings, and quality developed through quantitative measurements –scientific knowledge. Therefore, they defined it as the continuous capacity of the soil to work as a vital system within the limits of the ecosystem and soil use, to maintain the biological productivity, to maintain the quality of the air and to promote the health of plants, animals and humans (Parr *et al.*, 1992; Rasad and Coen, 1992; Doran, et al, 1994; Doran *et al.*, 1996.)

The interest in the evaluation of the health and quality has been stimulated by the knowledge of the soil like component of the biosphere. Therefore our challenge is to develop systems that balance the necessities and priorities for the production of foods and fiber, and with this to assure a safe and clean atmosphere, and the development of degradation and recovery indicators of the insane atmosphere. It has been recognized that in the past one used to put emphasis on the physic-chemical properties as only indicators of the soil quality, which made its prediction difficult. Nevertheless, the biological and ecological indicators are more reliable and dynamic and have the advantage to serve as early signals for degradation or recovery (Feijoo, 1999)

2.4 Local soil knowledge and management.

The rate at which poor peasants adopt technology in developing countries, has been a source of disappointment over the past decades. Initially, the low rates of technology adoption were attributed to ignorance, and problems in communication were addressed by better education and extension programs (Johnston & Clark, 1982; Orivel, 1983). More recently, farm-level resource constraints were perceived as a primary impediment to successful technology transfer (Chamber & Ghildyal, 1985 mentioned by Queiroz, 1992).

Investigations based on the local soil classification from the observable characteristics of the soil according to the agriculturists not always discover the different categories of the soil. The wealth of the soil can be evaluated through the quality of the zone by roots (Dumansky, 1993). The biophysical factors that determine the quality of the soil in the zone to rots and which consequently affect the agricultural production include: The apparent density, the hydraulic properties, the fertility and availability of nutrients, and the presence of toxic elements, among others. The objective indices to evaluate the impact of the agricultural production systems in the resource soil and the atmosphere can be based on observations on one or several of those factors. Despite the sustainability indices, they are only viable if they include considerations of sensitivity to the changes of handling and variability in the time and the space (Lal, 1994), in addition of being easy to measure.

2.5 The Concept of Indicators and Criteria for its Selection

The indicators can be defined as tools to add and to simplify the information of a complex nature in a useful and advantageous way (Adrianse, 1993). They are instruments to support the decisions which ought to be made; that means, they provide information in relation to the past and the possible future impacts of the same.

Normally a single indicator for all the system is not sufficient. A set of indicators, which describe the changes in the different important characteristics of a system for their sustainability, is required. There do not exist universal indicators for all the systems, instead, the indicators are defined in agreement with the specific properties of the system under analysis.

The indicators are used to measure the changes which can be caused by natural processes (the natural systems are not static but in continuous development) or human interventions, and these last ones are the center of interest when analyzing the sustainability. The observation of a change implies that the considered value of a certain indicator must be compared with some value that reflects the situation before human intervention or a sustainable situation; for example, the value of the same indicator or a similar but alternative system. The definition of these values of comparison is very important because the evaluation of the sustainability of a system depends in last instance on the elements with which they are being compared. (Sabine Mueller and Núñez Jorge, 1998).

The definition of indicators - according to Feijoo- becomes complex by the variation of the interactions in time, space and intensity. Nevertheless, it is recommended to initiate identifying the basic list of measurable properties that define the main processes in the operation of the soil. In agreement with Doran (1994), the indicators must satisfy the following suitability criteria:

1. Encompass ecosystem processes and relate to process-oriented modeling.
2. Integrate the soil's physical, chemical and biological properties and processes.
3. Be accessible to many users and applicable to field .
4. Be sensitive to variations in management and climate. The indicators should be sensitive enough to reflect the influence of management and climate on long-term changes in soil quality but not be so sensitive as to be influenced by short-term weather patterns.

5. Where possible, be components of existing soil data bases.

The chosen indicator must also be measurable by as many people as possible, especially managers of the land, and not limited to a selected group of research scientists. This indicator should define the major ecological processes in soil and ensure that measurements which have been carried out, reflect conditions as they actually exist in the field under a given management system. (Doran, 1995).

The indicators of soil quality vary in their sensitivity, for that reason it seems that there can be found reliable indices to prove that they serve as signal for monitoring and to predict the effects of the culture systems and the practices of handling in the productivity of the ground, environmental quality, nourishing security and quality of human, animal's and plants' health. The other goal in the future is to develop the mathematical relations or models which quantify the attributes of the quality of the ground, and from these derive one or more indices of simulation and prediction. It is vital that the indicators are related to functions of the ecosystems such as Carbon (C), Nitrogen (N), and components and variables of handling for processes of oriented models that simulate the routes of the ecosystems; therefore integration of physical chemical and biological indicators is required. (Feijoo, 1999)

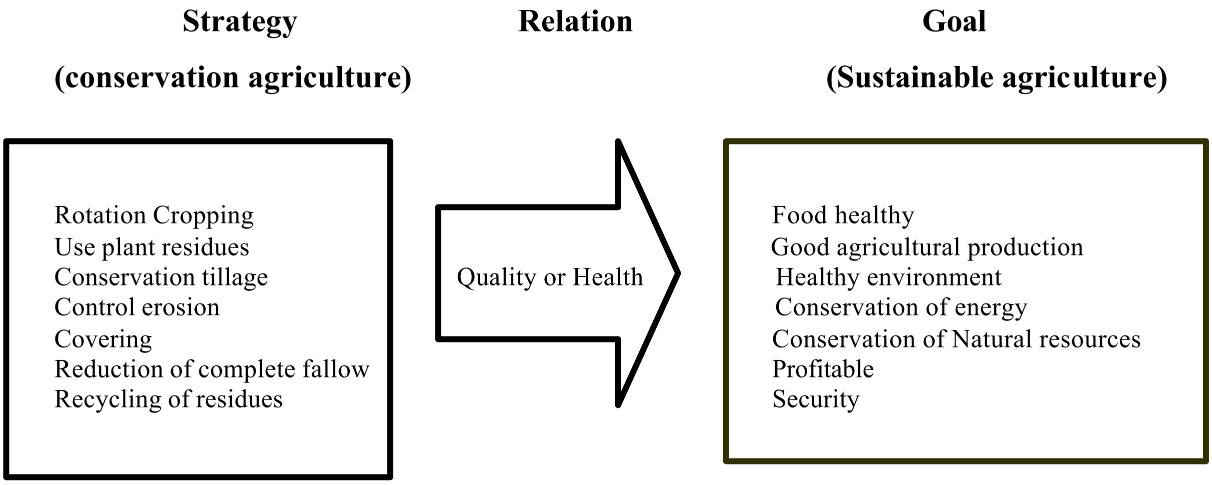
2.5.1 Local indicators of Soil Quality

A widely-accepted definition of soil quality (SQ) (Karlen et al. 1997) is the capacity of a soil to function in an ecosystem to support plants and animals, resist erosion, and reduce negative impacts on associated air and water resources. As a complex functional state, SQ may not be directly measurable, but may be inferred SQ indicator properties (Acton and Padbury, 1993) Initially, SQ evaluation focused primarily on the soil's chemical and physical properties, because simple methods of measurement were available (Larson and Pierce, 1991) More recently it has been suggested that the soil's biological and biochemical properties can serve as early and sensitive indicators of agroecosystem stress or changes in soil productivity (Kennedy and Papendick, 1995). The choice of indicator properties is likely to be related to the context in which the investigator views SQ. In making a regional or national resource investory, investigators are likely to emphasize such inherent soil profile properties as depth to a root-restricting layer, texture of surface and subsurface horizons, steepness of slope, and soil water regime.

The indicators of soil quality must be different for industrialized and developing countries. In the same way, the indicators differ for slope and valley agriculture, respectively. The indicators must be simple to generate, logical and applicable to field conditions and should be the expression of an accepted conceptual frame in the place, where they are developed, as they are discussed next. (Etchevers, 2000).

According to Hünnemeyer *et al.,* (1997), the advantage of the use of indicators is to count on the possibility of writing the most important aspects of the sustainability respect to a decision or set of decisions, in released form. This means, there's always a set of indicators needed, that must be defined according to the type of decision and hierarchic level. Thus, there would be indicators of soil quality applicable to global, national, regional level and of site, as it was already indicated in the previous section. (Etchevers, 2000).

The last concept behind the objectives that are persecuted when trying to find or to define indicators of soil quality, is sustainable agriculture and sustainability of the resource soil in the natural ecosystems. The sustainability concept, in its ampler meaning, talks about sustainable development, which is a political concept and not a scientific one, and there exist numerous definitions for the same one. Nevertheless, there are three elements or dimensions that are implicit in it: the ecology, the economy and the sociology. Parr *et al.,* (1994) present the following scheme which shows the importance that the quality of the soil has, uniting the strategies, and the goals that they persecute in sustainable agriculture (It see Fig. 2).



(Source: Etcheveres, 2000)

Figure 2: The soil quality and its relation between the strategies and the goals in sustainable agriculture

If the soil is degraded, it requires more resources in economic terms, of time, energy to produce less amount and quality of foods. On the contrary, if the degradation of the ground is reverted by means of the use of appropriate techniques, sustainable agriculture and the idea of a healthy ground can be reality (Gregorich, 1995).

The diagnosis and reversion of the soil degradation require to count on quality indicators. In industrialized countries the agriculturists use some observable indicators at first to determine the health of the soil (SQI 1998). Nevertheless, many of these concepts are also handled by the producers of the developing countries, and they resemble themselves the amplest possible concept of soil fertility. For the description of the health of the soil words related to the form are used, as it is seen, smelled and felt.

Next, some of the indicated concepts of health are described, by the agricultural producers. According to Etchevers- a healthy or fertile soil is:

1. Deep and dark -easy to plow- Absorbs and accumulates an important amount of water.

2. It is dried with relative facility - It allows that the harvest remainders are disturbed quickly, - Has a high percentage of organic matter and little erosion,

3. It has a high number of earthworms of several classes and a fresh and candy scent. The Indicators according to the Soil Quality Institute are associated to the soil perception the producers have, as for example:

- Outcrop of the subsoil.
- The change of color.
- Appearance of gully erosion.
- The superficial draining.
- The presence of weeds.
- The aeolian erosion.
- The deposition of the soil in specific places.

The objective soil indicators are chemical, biological and physical properties, processes and characteristics that can be measured for monitoring in the soil (SQI, 1996).
This is possible to be appreciated in the following (table 1)

Table 1: Soil indicator by Etcheveres, Acton and SQI

Healthy soil and Fertil According. (to Etchevers)	Healthy soils indirect effects (Acton and Gregorich)	Sensorial indicators Changeof quality (SQI, 1996).
Deep and dark	Consumption energy is smaller	The outcrop of the subsoil
Easy to plow	They spend except the equipment.	The change of the color
Absorbs and accumulates water	Smaller effort of the tractor	Erosion
It is dried relatively easy.	Little fertilizer use	Dry soil
It allows harvest remainders	Greater y ields	Superficial draining.
Decomposition quickly	Great variety of weeds	Answer of the cultures
High content of Organic Matter	Smaller problem with insects and diseases	Presence of weeds
Many earthworms	The harvests are better quality	Aeolian erosion
fresh scent		Soil accumulation in certain specific zones.

2.5.2 Chemical Indicators

Doran and Parkin (1994) have also selected chemical indicators for the assessment of soil quality. These indicators include (1) soil organic matter (OM), or organic carbon and nitrogen, (2) soil pH, (3) electric conductivity (EC), and (4) extractable available Nitrogen (N), Phosphorus (P). The chemical indicators include (1) soil pH, (2) electric conductivity (EC), (3) organic carbon (OC), (4) extractable available N, P, and K, (5) extractable available trace elements (Cu, Zn, Cd, and Pb) (See table 2). Standard soil fertility attributes (soil pH, organic carbon, available N, P, and K) are the most important factors in terms of plant growth, crop production and microbial diversity and function. As we know, these parameters are generally sensitive to soil management. For polluted or degraded soils, these soil fertility indicators are regarded as part of a minimum data set of soil chemical indicators.

Table 2: Chemicals indicator of soil

Evaluation	Affected Process
Organic Matter.	Recycling of nutrients, retention of water, and pesticides, structure of the soil.
Infiltration	Draining and superficial leaching; efficiency of use of the water, potential erosion.
Aggregation.	Structure of the soil, resistance to the erosion, emergency, infiltration.
pH.	Availability of nutrients, absorption and mobility of pesticides.
Microbial Biomass	Biological activity, recycling of nutrients, degradation of pesticides.
Forms of N.	Availability of N for plants them, potential leaching, rates of mineralization or potential immobilization.
Apparent Density.	Penetration by roots, porous space, biological activity.
Depth of the superficial soil	Volume of rooting, water availability and nutrients.
Conductivity or salinity.	Infiltration of the water, growth of the cultures, structures of the soil
Availability of nutrients.	Capacity to maintain growth, environmental danger

Source: Doran, 1999

2.5.2.1 The acidity: pH and the aluminum content

The acidity of the soil can be measured through pH and the aluminum content and takes place by the nonacid cation extraction (like calcium and magnesium), which makes the cultures, or those which are lost by leaching or erosion. Another factor which acidifies the soils is the nitrogen fertilizers that contain or form ammonium when they are hidrolized, for example ammonium sulphate and urea. The acidity affects the soil quality, as it increases the activity of pathogenic microorganisms which attack the plants' roots and produce severe damages. In addition to which the acidity affects the availability of some elements. If pH is acid, the availability of copper, iron is favored and zinc and diminishes the molybdenum availability. In conditions of strong acidity, the manganese and aluminum contents tend to increase in the solution of the soil and can cause toxicity to the plants.

When the calcium is acidity, magnesium and potassium diminish quickly producing deficiencies in the plants. Therefore the value of pH and the aluminum content are indicating degradation in the quality of soil (Kass, 1997).

2.5.2.2 Nutrients of soils

It is the product of the interrelation between physical, chemical and biological factors. The nutrients constitute a single part of a series of factors which include the relation between cations, the saturation of bases, acidity, microbial activity, humitys substances that participate in the recycling of nutrients and organic carbon sources for the microorganisms of the soil, in addition to the content of nutrients that is evaluated with interpretation tables. All these elements, depending on the contents, allow to distinguish a fertile soil from another one of low fertility. This parameter is the effect of one or indicating of the ground; therefore, it is possible to be defined as a secondary indicator derived from the integral analysis of other indicators (Kass, 1997).

2.5.2.3 Percentage of organic matter and organic carbon

The organic matter influences the chemical, physical, and biological properties of the soil:
Chemical Properties: It provides by recycling (N), (P), (S), micronutrients like (Faith), (b) and (Zn); It inactivates herbicides, besides offering resistance to molecules of pesticides, so that they are washed to deep layers or they move by run-off to water tanks and / or rivers.
Physical Properties: Favors the development of mesoporos and macropores for the ventilation of the soil, the water retention and the aggregate formation of the soil.

Soil organic matter is that fraction of the soil, composed by anything that once lived. It includes plant and animal remains in various stages of decomposition, cells and tissues of soil organisms, and substances from plant roots and soil microbes. Organic matter is an essential component of soils because it impacts physical, chemical, and biological components of soil quality.

Generally, organic matter makes soil more friable, less “plastic” or sticky, and easier to work. It stabilizes and holds soil particles together in aggregates, reducing raindrops splash damage that can lead to erosion. By improving pore size distribution and decreasing bulk density, it improves the soil’s ability to store and transmit air and water.

Soil organic matter is an energy source for microbial metabolic processes. Microbes derive energy from organic matter by breaking C bonds in the organic matter. The end products of organic matter decomposition are carbon dioxide and water. The elemental constituents of organic matter, primarily Carbon (C), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), and minor elements, are required for growth of plants and soil organisms. As soil organic matter decomposes, these nutrients become available for uptake. They are also adsorbed by and retained at soil cation- and anion- exchange sites. Soil organic matter contributes to nutrient retention by increasing exchange capacity. (Doran,1996).

Characteristics of biological: It serves as substrate for the development of microorganisms and mesofauna of the soil, whose main activities are the liberation or immobilization of nutrients.

Table 3: Proposed minimum data of physical, chemical, and biological indicators for screening the condition, quality and health of soil.

Indicators of Soil	Relation to soil condition
Physical	
Texture	Retention and transport of water and chemical
Depth of soil	Estimate of productivity potential
Water holding capacity	Potential for leaching
Chemical	
Soil organic matter(OM)	Defines soil fertility
pH	Defines biological and chemical activity
Electrical conductivity	Defines plant and microbial activity
Extractable N,P,K	Plant available nutrients and potential for N
Biological	
Microbial biomass C and N	Microbial catalytic potential and repository for C and N
Potentially mineralizable N	Soil productivity and N Supplying potential
Soil respiration, water content, temperature	Microbial activity measure

Source: Doran and Parking, 1994 and Larson and Pierre 1994

2.5.3 Physical Soil Indicators (See Table 3)

Doran and Parkin (1994) have selected some physical indicators for the assessment of soil quality. These indicators include (1) soil texture, (2) depth of soils, topsoil or rooting, (3) infiltration, (4) soil bulk density, and (5) water holding capacity. The physical indicators he selected included (1) depth of the A horizon, (2) soil texture classes or contents of clay, silt, and sand %, (3) bulk density, (4) available water content (%), and (5) aggregate stability at a depth of 30 cm. It is easy to understand that measuring the bulk density, soil texture, and penetration of resistance (or infiltration) can provide useful indices of the state of compactness, and the translocation of water, air and root transmission. Measurements of infiltration rate and hydraulic conductivity are also very useful data, but are often limited because of the wide natural variation that occurs in field soils, and the difficulty and expense of making enough measurements to obtain a reliable average value (Cameron *et al.,* 1998). Measuring the aggregate stability gives valuable data about soil structural degradation, which is often affected by pollution (e.g. sodium) and soil degradation (loss of organic matter). This shows that visual assessment of the soil profile is a very valuable way of assessing the physical condition of the soil, and whether there is a need for soil reclamation or remediation. These physical indicators should include:

1. Soil texture: related to porosity, infiltration, and available water content.

2. Bulk density: related to infiltration rate and hydraulic conductivity.

3. Aggregate stability: related to soil erosion resistance and organic matter content.

Beare *et al.,* 1997 have proposed a quantitative method to show the decline and restoration of soil structure conditions in a typical mixed-cropping rotation system over eight years.

2.5.4 Biological Soil Indicators

An indicator is a property, characteristic or process that can be measured to detect changes in the studied system. The biological indicators include measures of populations of micro and microorganisms, their activity or by-products that allow the evaluation of the impact that the agricultural practices exert on environment .(Kennedy and Papendick,1995; Mukel and Mauchbach, 1996). The rate of breathing for microbial activity is also considered like indicator, ergosterol or other by-products of the fungi (to measure activity of the organisms which plays an important role in the formation and stability of aggregates of the soil).

Doran and Parkin (1994) have selected a number of biological indicators for the assessment of soil quality. These include: (1) microbial carbon and nitrogen, (2) potential mineralizable nitrogen (anaerobic incubation) and (3) soil respiration, water content, and soil temperature. The chemical indicators include (1) potential mineralization of N, (2) C, N, and P present in the microbial biomass (3) soil respiration, (4) the number of earthworms, and (5) crop yield. Soil biological parameters are potentially early, sensitive indicators of soil degradation and contamination. It follows, then, that the minimum data sets for assessing key soil processes are composed of a number of biological (e.g. microbial biomass, fungal hyphae) and biochemical (e.g. carbohydrate) properties (Cameron *et al.,* 1998). Two of the most useful indicators are microbial biomass and microbial activity. Microbial biomass is a sensitive indicator of a long-term decline in total soil organic matter, but does not seem to be a sensitive indicator of the effects of organic pollutants applied to fields. (table 3).

The measurement of soil quality must be aimed especially to detect changes which can occur within the period of 1 to 10 years (SQI, 1996). Interpreting the indicators of soil quality, it varies due to differences in parental material, topographic conditions, climatic positions in the landscape, soil organisms and the type of vegetation. The effort to realize an adequate interpretation of the indicators still is to be done. It is necessary to establish acceptable ranges, the changes in time, as well as other variable aspects, with the aim of realizing the best possible interpretation. (Etchevers Jorge D, 1997)

Not all of the previously exposed indicators are used. Recently, there have been efforts to define a minimum number of measurements, which give an idea of the changes that are taking place in the soil. These measurements vary according to the soil´s function that is being observed, the possibility in the time of observation, and the soil´s location in the landscape. (Karlen *et al.,* 1997)

2.6 Erosion and depth of the Horizon A

Erosion is the loss of the soil by hydric or Aeolian action. The main type of erosion in this region is the hydric one by splash, to laminate orgully erosion. The method described by the FAO refers to the visible damage done to the soils by accelerated erosion. In order to measure the erosion degree, one uses the field observation of pedestals and naked roots, the existence of cracks, terracetas, furrows, gully erosion and slidings, the removal of masses and the sediment accumulation in the foot of slopes and routes of water-drainage.

The measurement of the soil quality must be aimed especially to detect the changes that can happen in a period between 1 - 10 years (SQI, 1996). In the interpretation of the indicators of quality of soil it varies by differences in parental material, topographical conditions, and climatic position in the landscape, organisms of the soil and type of vegetation. The work to obtain a suitable interpretation of the indicators still is about to be done. It is precise to establish acceptable ranks, the changes in the time, the variances, etc. in order to make the best possible interpretation. (Etchevers Jorge D, 1997).

2.7 Ethnopedology

2.7.1 How the peasants classify their soils?

Williams and Ortiz Solorio (1981) proposed that "ethnopedology" as a field of study should encompass folk perception of soil properties and processes, folk soil classification and taxonomy, folk theories and explanations of soil properties and dynamics, folk soil management, folk perceptions of the relationships between soil and plant domains, comparison between folk and technical soil science, and an assessment of the role of other behavioral realms.

Despite little interdisciplinary between anthropology, geography, and the agricultural science- the three disciplines concerned with locals soil classification and use –a respectable -although disjointed- literature has been generated. Not surprisingly, the different academic disciplines have historically looked at the topic of local soil knowledge and management through their own methodological and theoretical lenses. Thus, most early ethnographers to study soils (Conklin, 1957; Malinowsky, 1965; Netting, 1968; Redfield and Villa, 1934 cited by Talawar, 1997) looked at soil classification as a vehicle in a Broader effort to understand the internal workings of non –Western culture. Early ethnopedology –much like the more established ethnobotany –was mainly an attempt to uncover cognitive aspects of unfamiliar cultures through the analysis of rules, plans schemes, symbols and categories (Guillet 1995, Cited by Talawar, 1997). Interesting information on indigenous soil knowledge, or ethnopedology, has emerged recently. In a study of soil knowledge and management in the highland region of Perú (Guillet, D.W et al 1989 cited by Roman *et. al.*, 1992, cited by Talawar, 1997) a computer model was used to generate a folk expert system for indigenous soil taxonomy.

2.7.1.1 Descriptive classification

The local soil classification is based on the peasants' description and observations of the soils'qualities. In some cases they classify it as "good" or "bad" for growing certain crops based on vegetative indicators, drainage, texture and fertility. Other agriculturists have distinguished the quality basically by the color, capacity of humidity retention, requirements of irrigation and smoothness of the soil.

The acidity affects the soil quality, as it increases the activity of pathogenic microorganisms which attack the plants' roots and produce severe damages (Roming *et al.,*1995). It becomes necessary to interpret the knowledge of the agriculturists with respect to quality of soils and to obtain a suitable perception of the dedicated displays. The perception of the agriculturists was gathered using adapted questionnaires written for the Program of quality of soils of Wisconsin. The properties of the soil include: texture, color, depth, density, rate of infiltration, capacity of retention of the water, structure, contained of nitrogen, phosphorus, organic matter, pH, electrical conductivity, activity earthworms, and scent.

2.7.1.2 Peasants' knowledge and scientific knowledge

To successfully address these new expectations, agricultural research will likely require integrated, system-level research approaches.

Agricultural research has exclusively addressed problems in agriculture, not the problem of agriculture (Jackson, 1980). This is reflected by a predominant research emphasis on increasing short-term technical and economic efficiency of agricultural production. Thought the problem of agriculture has yet to be addressed, expectations of agricultural research have broadened appreciably in recent years. Expectations of agricultural research have broadened appreciably in recent years. Expectation now include finding ways to reduce consumption of non renewable resources, avoid environmental damage, minimize toxic residues in food, reverse deterioration of rural communities, and more generally, preserve long-term productive capacity" (Lockeretz and Anderson, 1993, Cited by Doran 1994). Much of the agricultural research has followed the more traditional sciences in a discipline oriented paradigm. This paradigm, developed by Francis Bacon and advanced by René Descartes, is based on reduccionistic methods that place priority on the parts of things over the whole (Jackson and Piper, 1989). In addition to its obvious inappropriateness for multifaceted research problems, the specialization associated with this scientific paradigm has allowed disciplines within agricultural research to become intellectually self-contained. As a result, societal concerns and problems are not always effectively addressed, because the "questions and products" of research are determined and reviewed within disciplinary boundaries (Weinberg, cited by Doran 1994).

Recent research has underscored differences between local knowledge systems and the science. Although local knowledge often embodies substantial observation-derived understanding of biophysical processes and artifacts, it is distinct from science, as the latter is conventionally defined. Primary differences include those between trial and error learning versus scientific control-centered experimentation and knowledge and its applications. One example of these differences is shown by study of local plant knowledge. Local systems of biological classification commonly exhibit non-exclusive taxonomic relations, a property which differs from the hierarchic structure of scientific taxonomies. These findings indicated that local understanding of the biophysical world often differ with respect to the conventional ones of science and scientists (Zimmerer, 1994)

Studies of laboratory and statistical analysis of the chemical and physical properties of the soil to evaluate the soil, validate the local soil classification very well (Behrens, 1989; Bellon, 1990; Brandley, 1983; Conklin, 1957; Carter, 1969; Jonson, 1983; Queiroz and Norton, 1992; Williams and Ortiz-Solorio, 1981) - Cited by Talawar, 1998 - physico-chemical analysis soil and properties of local soil classification validates the hypothesis of the veracity of the classification of grounds by the agriculturists. Studies of Brazil (Queiroz and Orton, 1992) with morphologic data (texture, color, etc) gathered in the field were put under cluster and analysis of main components with one narrow correspondence with the groups of soils according to the local classification.

Some research even made efforts to understand the local soil perception by comparing local soil classification system with technical soil classification system (Kerven *et al*., 1995, Talawar, 1991, 1998). However, many of the studies (Dialla, 1993; Grobben, 1992; Talawar, 1991) did not employ any physico-chemical analysis of soil to "scientifically" validate the criteria of classification by the farmers.

Among all the soil characteristics, texture and color are still the most salient and defining for farmers in local classification (Carter 1969; Conklin, 1957; Kerven *et al.,* 1995; Williams and Ortiz 1981; Talawar , 1998)

Ortiz Solorio compared the local soil taxonomy with the folk biological taxonomy and pointed out the differences and similarities in the structure and nomenclature pattern in both taxonomical systems. And he concluded that the fit between biological nomenclature patterns and soil nomenclature was less than perfect, whereas structurally there was significant similarity between both the taxonomical systems.

In field level and scientific soil classification, the multiple criteria in soil phase mapping are somewhat similar to what farmers employ in a local soil classification. Thus, the comparison of field level scientific soil classification and soil survey maps with that of local soil classification can be of great value in comparing the perception, regarding soil properties between scientists and farmers.

It is necessary to establish a correlation between the comments of the peasants and the different types of land, and thus to understand the local knowledge. This way, it can be understood better, as the knowledge of the peasants about the quality of the soil serves to obtain a good interpretation of the dedicated displays of peasants. For that reason it was necessary to elaborate a questionnaire of questions hat contains the main characteristics with respect to the indicators of quality of soils.

Indigenous Knowledge

There is an increased interest in the knowledge of traditional agriculturalists with the realization that they commonly possess a wealth of information about their environment. Indigenous knowledge, including that about soil, constitutes a valuable cultural resource, paralleling and directly related to conservation of traditional crop varieties and overall biological diversity. It is especially important now, to record this knowledge as many cultures are losing their traditional land use bases due to economic and social change and assimilation into the industrialized world. A broader understanding of indigenous soil knowledge and traditional agriculture may benefit agricultural development by providing a more environmentally sound and culturally acceptable basis for technological change in agriculture (Acres, 194; Bocco 1991; Mossi *et al.,* 1991; Pauluk *et al.,* 1992; Tabor, 1992; Bellon and Taylor, 1993; Beac and Dunning, 1995 – Mentioned by Sandor and Furbee, 1996).

With its emphasis on practical agricultural management, the indigenous classification is perhaps more closely related to use-oriented classification, such as the Fertility Capability Soil Clasification System (FCC) (Sanchez *et al*., 1982), than to pedology-based system such as soil taxonomy. In both the indigenous and FCC systems, emphasis is on surface and subsurface soil properties that are directly applicable to plan growth. (Sandor and Furbee, 1996).

Peasants know very much about their land and seem well-served by their own system. In practical terms, the indigenous soil classification is sufficient for managing present fields in traditional ways. However systems such as soil taxonomy and the FCC could be useful for planning and implementing agricultural projects involving new lands and modern technology.

Knowledge construction is the process of defining reality and includes then manner in which we recognize and interpret our social cultural, and material environments. Knowledge construction thus includes social interactions, communication and the diverse processes individuals employ to create, use, and evaluate multiple types and sources of information. Research utilizing a knowledge systems approach, recognize the impact of social structures, process, and institutions in shaping the knowledge of individuals. They also acknowledge the contributions of individuals as actors to define and construct knowledge, based on their unique social, personal, cultural, political, historical and ecological context (Long and Long 1992; Swidler,1994) (Mentioned by Raedeke, 1997).

While scholars of knowledge systems have provided an array of theorical and applied contributions, research pertaining to local, traditional, and indigenous knowledge system is the most relevant to our discussion of knowledge. (Raedeke, 1997).

Researchers tend to position science as an external agent of change associated with research establishments and expertocracies located outside of local areas (Bush *et. al.* 1991; Kloppenburg, 1988). Scientific researchers are portrayed as representing 'outside' interests and farmers, who produce localized knowledge, are portrayed as representing 'insider' interests. (Thompson and Scoones, 1994) point out that this creates a false assumption of homogeneity among farmers and discounts the presence and interactions between different actors and networks within a locality. As a result, farmers are typically assumpted to be passive recipients of scientific knowledge which makes it more difficult for research institutions to know how farmers themselves may utilize and produce scientific types of knowledge Mentioned by Raedecke, 1997).

Today, advocates of sustainable agriculture recognize the importance of diverse knowledge systems, including indigenous or local knowledge, for the development of sustainable agricultural systems in less industrialized countries (Altieri, 1989).

2.7.1.3 Scientific evaluation of local soil classification

These studies have used laboratory and statistical analyses of physical and chemical properties of soils, to evaluate and validate how well the local soil classification systems accounts for scientifically-defined properties of soil (Behrens, 1989; Bellon, 1990; Bradley, 1983; Conklin, 1957; Carter, 1969; Johnson, 1983; Queiroz and Norton , 1992; Williams and Ortiz, 1981). (See table 4)

In a Brazilian study (Queiroz and Norton, 1992), data on morphological attributes (e.g., texture, color) were collected from the field and further subject to cluster analysis, leading to the conclusion that the composition of numerically derived clusters corresponded closely with the grouping of soils in accordance with the local classification.

2.8 Peasant's conception of soil fertility and management

Scientists generally consider the nutrient status of soil apart from its physical condition in evaluating soil fertility levels although scientific land use classification systems are used for rating the quality of different soils for production. Typically, soil fertility test are carried out to identify the deficiency of soil nutrients so that they could be rectified by applying fertilizer, and soil amendments in general.

The ethnographic record shows that the peasants' idea of soil fertility and its maintenance differs from that of scientists. For example, Talawar (1991) indicated that the peasant's in semi-arid regions of south India considered comparatively less fertile sandy soil as fertile " rich" soil because of its quality of high water permeability not because of micronutrient or minerals. The same peasants rated different soils based on their "productive capacity" as measured by crop performance at a know level of compost manure, in most cases. Factors considered for rating certain soils as "fertile" included: sustainable productivity, high permeability, and water holding capacity, few tillage operations, ease of operations and low requirement of composted manure (Talawar, 1991-1999).

Small –scall farmers, engaged in complex, diverse and risk-prone agriculture, are know to take advantage of soil variability, crop diversity, and climate variations in order to enhance soil fertility and maximize yields (Sillitoe, 1996).

Farmers use organic as well as inorganic fertilizers to improve soil fertility including crop residues, digested residues of hedges, cattle manure, silt from community ponds, forest tree residues, and chemical fertilizers.

Table 4: Comparison of farmers'criteria of soil classification with the results of soil analysis for physico-chemical properties.

Studies.	Framer´s criteria.	Soil Characteristics analyzed	Remarks (based on soil analysis)
Behrens 1989	Texture.	S,P, pH, EC, N, P, K,Ca, Mg	Shipibo soils distinguished on pH, N, P, K, S, P.
Bellon 1990	Texture, retention Water, fertility, ability to work.	Sand, Silt, Clay,pH, N, CEC, Ca, Mg.	Soil analysis results were consistent With farmer´´s criteria.
Conklin 1957	Texture, color.	pH, NH2, NO3, P, K, Ca, Mg, Mn, Fe	Local soil fertility rating matched with the results of soil analysis for pH, Ca, Mn, P, K, NO_3.
Carter 1969	Texture, Color, .	Texture, pH, Ca, Mg, N, P, K	Local soil productivity rating matched with the fertility status and drainage properties.
Johnson 1983	Textur, Color, drainage, fertility, slope	Organic matter, N, Sand, Sild, Clay	Most preferred soils contained usually high amount of N and organic matter.
Queiroz y Norton 1992	Texture, color, structure, depth.	Texture, Color, Depth, Consistency, Structured Horizon boundary, Stones	Among all the characteristics analyzed, moisture and pH distinguished the soils.
Williams and Ortiz–solorio (1981)	Color, Texture, Consistency, Moisture, Workability, Vegetative cover	Clay, pH, Field Capacity, Organic matter, N, P, K, Na.	Soil analysis validated the measurable difference between different local soil classes.

Source: Talawar: 1999

2.8.1 Local concepts of soil fertility

Group discussions in both villages, revealed that peasants and scientists have different concepts of soil fertility. Scientists often only take account of the soil's nutrient status into account, without considering its physical properties. They define fertile land as land which is capable of producing consistently high yields in a wide range of crops.

Farmers' perceptions of soil fertility are not limited to the soil's nutrient status. Fertility is assessed through outcomes such as crop performance and yield and includes all soil factors affecting plant growth. In fact, the farmers' interpretation of soil fertility reflects the definition of soil productivity used by the International Soil Science Society (ISSS). The ISSS describes the ability to produce a specified plant or sequence of plants under a particular system of soil management as the capacity of a soil in its normal environment (ISSS, 1996). In their critical analysis of how farmers in different settings classify and manage soils, Talawar and Rhoades (1997) also found out that farmers consider soil fertility as a multi-facetic concept. It includes factors such as the soil's capacity for sustainable productivity, its permeability, water holding capacity, drainage, tillage and manure requirements, and how easy it is to work.

The peasants in our case study use various easily observable indicators to assess whether soil fertility is declining. The principal indicator they mentioned is reduced crop yield. In this semi-arid region where rainfall is low and erratic, soil moisture conservation is often regarded as the most critical factor for successful crop production. Peasant perception of soil fertility is therefore closely related to the soil's water holding capacity. However, even in climatically good years, low crop yields are not perfect indicators of declining soil fertility, since yields may be significantly affected by a range of other factors, such as weeds or pests.

Peasants use the appearance of specific weed species, like *Echinips hispidus* and *Xanthium spinosum,* as indicators of declining soil fertility. As individual weed species or communities are adapted to particular habitats, their presence may indicate problems with the soil's nutrient status or structure.

Farmers also listed rocky outcrops and crops wilting at the end of the rainy season as indicators of declining or low soil fertility. Rocky outcrops may appear as result of high levels of erosion, and they are often associated with shallow, infertile soils. Crops that wilt just after the rainy season ends indicate that the soil has low water holding capacity, which is related to certain physical characteristics such as depth and texture. (Corbeels, and Shiferaw 2000).

The soils are classified according to recognizable and easily identifiable soil and field characteristics. In our study area the peasants' criteria for classification are yield, the topographic position of the field, the soil's depth, color and texture, its capacity to hold water, and the presence of stones. Peasants ranked these criteria in the following order: yield >

topography > soil depth/color/texture/waterholding capacity/stoniness. Yield is the most important criterion, and peasants are also aware that soil productivity is closely related to its position within the landscape. They regarded the other five criteria as equally important.

Soil color is an important criterion for farmers, as it often reflects the soil's hidden parent material, which determines specific soil characteristics. The texture of the surface layer has some influence on many other soil properties, and gives farmers a clear indication as to whether a soil can be cultivated after the first rains of the season. Other criteria mentioned by farmers are soil compaction, structure, cracking patterns, stoniness, drainage, and the ability to retain moisture. All of these physical characteristics are related to soil texture.

Farmers were asked to rank the different local soil types according to their fertility and potential productivity. (Corbeels and Schiferaw,2000)

2.9 Agroecosystem

The challenge in creating sustainable agroecosystems in order to achieve natural ecosystem-like characteristics while maintaining a harvest output. Working towards sustainability, the manager of any particular agroecosystem strives as much as possible to use the ecosystem concept in designing and managing the agroecosystem. Energy flow can be designed to depend less on non renewable sources. Thus, a better balance between energy used to maintain the internal processes of the system can be achieved which is available for export of harvestable goods. The peasants can strive to develop and maintain nutrient cycles that are as “closed” as possible, to lower nutrient losses from the system, and to search for sustainable ways to return exported nutrients to the farm. Mechanisms to regulate the population can depend more on system-level resistance to pests, through an array of mechanisms that range from increasing habitat diversity to ensuring the presence of natural enemies and antagonists. Finally, an agroecosystem that incorporates the natural ecosystem qualities of resilience, stability, productivity and balance, will better ensure the maintenance of the dynamic equilibrium necessary to establish an ecological basis for sustainability. (Gliessman, 2002).

2.9.1 Agroforestry Systems

The term agroforestry has been given to practices that intentionally retain or plant trees on land, used for crop production or grazing (Wiersum 1981; Nair 1983). Such systems combine elements of crop or animal agriculture with elements of forestry, either at the same time or in sequence, building on the unique productive and protective value of trees. There are many variations in practices that belong to the category of agroforestry: in agrosilviculture, trees are combined with crops; in silvopastoral systems, trees are combined with animal production; production; and in agrosilvopastoral systems, the peasant manages a complex mixture of trees crops, animals.

It is in the tropics and subtropics, where the peasants and agriculturists integrate cultures, trees and animals to produce nutrients, fibres, combustibles and forage protecting their natural resources.

2.10 Advantages of sustainable agriculture

"Slash and burn" or "milpa" is perhaps one of the best examples of an ecological strategy to manage agriculture in the tropics. By maintaining a mosaic of plots under cropping and some in fallow, farmers capture the essence of natural processes of soil regenaration typical of any ecological succession. By understanding the concept of the milpa, a contemporary discovery, the use of "green manures", has provided an ecological pathway to the intensification of the milpa, in areas where long fallow periods are not possible anymore, due to population growth or conservation of forest to pasture (Flores, 1989).

Experiences in Central America show that vet bean, "mucuna" (Mucuna pariens) based maize systems are fairly stable allowing respectable yield levels (usually 2-4 mg ha) every year (Bukcles *et al.,* 1998). In particular, the system appears to greatly diminish drought stress because the mulch layer left by mucuna helps to conserve water in the soil profile.

2.10.1 Agroecology as a fundamental scientific basis for natural resource management

Agroecoloy goes beyond a one-dimensional view of agroecosystems- their genetics, agronomy, edaphology, etc. –to embrace an understanding of ecological and social levels of co-evolution, structure and function. Instead of focusing on one particular component of the agroecosystem, agroecology emphasizes the inter-relatedness of all agroecosystem components and the complex dynamics of ecological processes (Vandermeer 1995).

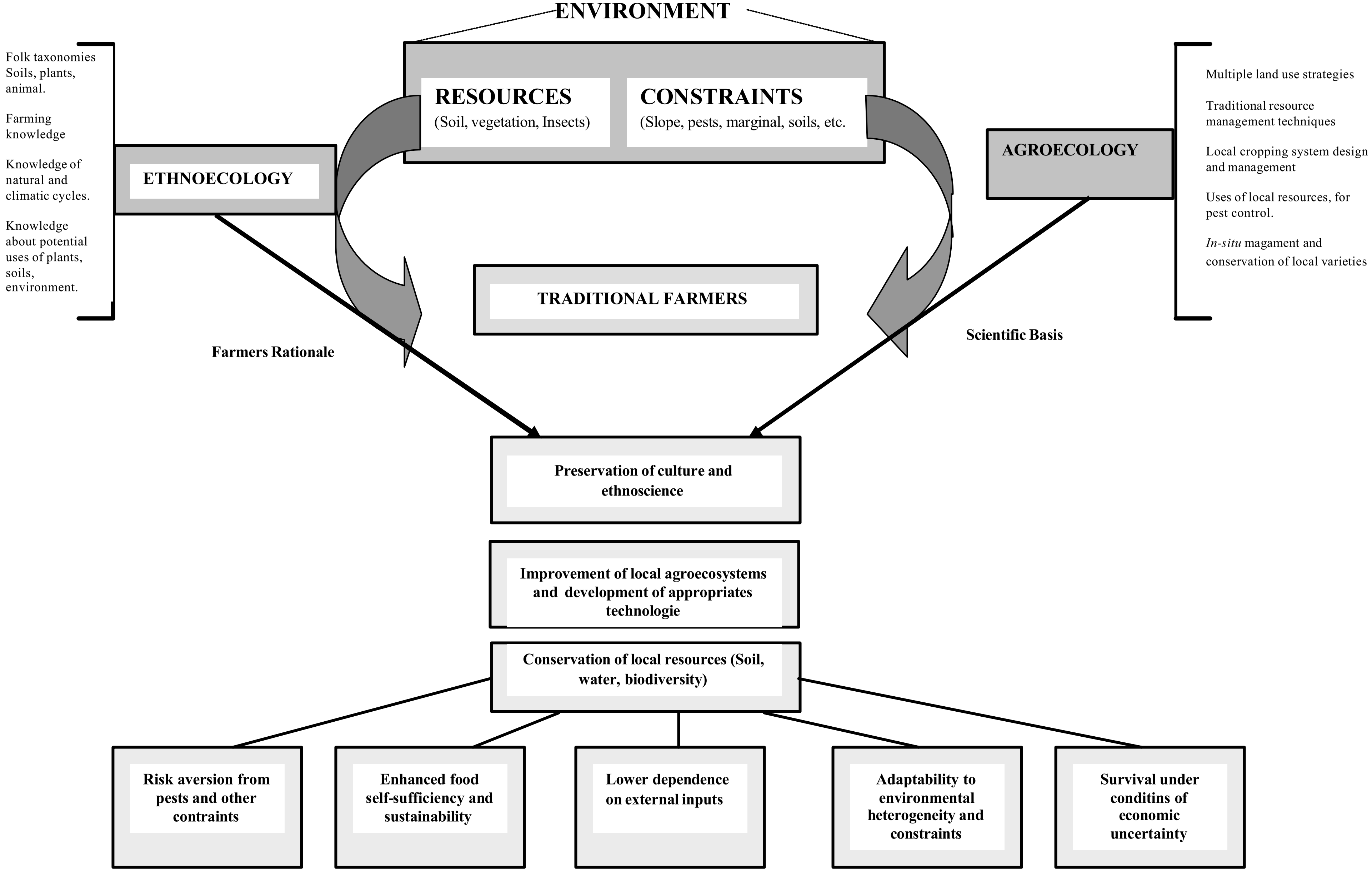
Agroecosystems are communities of plants and animals interacting with their physical and chemical environments that have been modified by people to produce food, fiber, fuel and other products for human consumption and processing.

As a point of departure we can offer an initial definition of agroecology. What is intended is the "ecological management of biological systems" through collective forms social action, in order to redirect the course of "coevolution" between nature and society and thereby address what has been called the "crisis of modernity". This is to be achieved by "systemic strategies" which control the development of the forces and relations of production selective to change modes of human production and consumption that have produced this crisis. The local dimension where we encounter "endogenous potential" encoded within knowledge systems (local, peasants or indigenous) is a central aspect within such strategies. These knowledge systems allow for and promote both ecological and cultural diversity", which should form the starting point of alternatives agricultures. In turn these provide the basis for the establishment of dynamic yet Sustainable societies. (Sevilla and Woodgate, 2000).

Agroecology is the holistic study of agroecosystems, including all environmental and human elements. It focuses on the form, dynamics and functions of their interrelationships and the processes in which they are involved. An area used for agriculture production, eg. fields, is seen as a complex system in which ecological processes are found under natural conditions. Thus, nutrient cycling, predator/prey interaction, competition, symbiosis, succesional changes, etc. take place (Gliessman, 1998) Implicit in agroecological research is the idea, by understanding these ecological relationships and processes, that agroecosystems can be manipulated to improve production and to produce more sustainability, with fewer negative environmental or social impacts and fewer external inputs (Gliessman, 1998).

Agroecology takes greater advantages of natural processes and beneficial on-farm interactions in order to reduce off-farm input use and to improve the efficiency of farming systems (Reinjtes *et al.,* 1992). Technologies that have been emphasized, tend to enhance the functional biodiversity of agroecosystems as well as the conservation of existing on-farm resources. Promoted technologies such as cover crops, green manures, intercropping, agroforestry and crop-livestock mixtures, are multi-functional as their adoption usually means favorable changes in various components of the farming systems at the same time (Gliessman, 1998).

Fig. 3 The role of agroecology and ethnoecology in the retrieval of traditional farming knowledge and the development of sustainable agroecosystems, including appropriate innovation in pests magament



Source: Altieri 2001

Most of theses technologies may function as an “ecological” turntable” by activating and influencing components of the agroecosystem and processes such as:

1. Recycling of biomass and balancing nutrient flow and availability.
2. Securing favorable soil condition for plant growth, through enhanced organic matter and soil biotic activity.
3. Minimizing losses of solar radiation, air water and nutrients by way of microclimate management, water harvesting and soil cover.
4. Enhancing species and genetic diversification of the agroecosystem in time and space.
5. Enhancing beneficial biological interactions and synergisms among agrobiodiversity components, resulting in the promotion key ecological processes and services.

In Costa Rica, researchs conducted spatial and temporal replacements of wild species by botanically /structurally and ecologically similar cultivars. Thus, successional members of the natural systems of the natural system such as *Heliconia spp*., cucurbitaceous vines, *Ipomoea* spp. Legume vines, shrubs, grasses, and small trees were replaced by plantain (*Musa sp*.) squash (*Cucurbita sp.*) varieties, and yams (*Dioscorea spp.)*. By years 2 and 3, fast-growing tree crops (Brazil nuts Bertholletia excelsa), peach (*Prunus persica),* palm (*Chamaerops spp.*) rosewood (*Dalbergia spp*.) may form an additional stratum, thus maintaining continuous crop cover, avoiding site degradation and nutrients leaching, and providing crop yields throughout the years (Ewel, 1986) According to Ewel (1999), the only region where it would be advantageous to imitate natural ecosystems rather than struggle to impose simplicity through high inputs in ecosystems that are inherently complex, are the humid tropical lowlands. This area epitomizes environments of low abiotic stress but overwhelming biotic intricacy. The key to agricultural success in this region is to (i) channel productivity into outputs of nutritional and economic importance, (ii) maintain adequate vegetational diversity to compensate losses in a system simple enough to be horticulturally manageable (iii) manage plants and herbivores to facilitate associational resistance, and (iv) use perennial plants to maintain soil fertility, guard against erosion, and make full use of resources.

Surveys conducted in hillsides after Hurricane Mitch in Central America showed that farmers using sustainable practices such as cover crops, intercropping and agroforestry suffered less damage than their conventional neighbours. The survey, spearheaded by the campesino movement, movilized 100 farmers-technician teams and 1734 farmers to carry out paried observations of specific agroecological indicators on 1804 neighboring, sustainable and conventional farms. The study spanned 360 communities and 24 departments in Nicaragua, Honduras and Guatemala. Sustainable plots had 20-40 % more topsoil, greater soil moisture, less erosion and experienced lower economic losses than their conventional neighbors (Holt and Gimenez, 2001). These data are of great significance to resource-poor farmers living in marginal environments and should provide the basis for nature resource management strategy that privileges the temporal and spatia1 diversification of cropping systems as this leads to higher productivity and likely to greater stability and ecological resiliency (Altieri, 2002).

2.11 Effects of natural areas on agriculture

Also important is the interaction of organisms and physical processes located in different habitat patches. The study of these factors, and how they are shaped by the spatial patterning of the landscape, is known as landscape ecology. Because it helps us understand how the different parts of the landscape mosaic are formed and how they interact, landscape ecology provides a good basis for management of the agricultural landscape (Barret, *et al*. 1990 Cited by Glessman).

Natural areas can have a variety of direct and indirect influences on agriculture. It is often asserted that the greatest significance the forest hat for agriculture is the protection of watersheds, thereby ensuring flood protection, reducing erosion, and improving groundwater supplies. On these points the evidence is ambiguous and considerable confusion about deforestation of hills, inevitably leading to laterization of soils, is found in the literature. So one commonly reads in the popular environmental literature that deforestation of hills inevitably increases the severity of floods and droughts and that reforestation improves groundwater supplies and reduces the severity of floods. In fact, the existing information from catchments experiments is quite complex and difficult to interpret and evaluate. In very few cases have flood events and groundwater conditions been adequately measured within a single catch basis before and after deforestation. Few have been measured before and after the reforestation of denuded basins. And in no cases have experimental designs have been adequate to avoid the weaknesses of pseudoreplication (Sensu Hurlbert, 1984. Cited by Glessman, 1998).

3. The Investigation Site

Cabuyal is situated in the Cauca department in south-western Colombia (2° 53' N 76°35'W) between 1200 and 1600 m above sea level. The mean temperature is 17° C and the average annual rainfall amount 2100 mm.

3.1 Climatology

The climate is bimodal with two periods of rains and two droughts. The months of less rain are December, January and August with a monthly average of 125.4 mm, whereas the rainiest months are of March to May of September to November. See data gathered by the CIAT Figure 4.

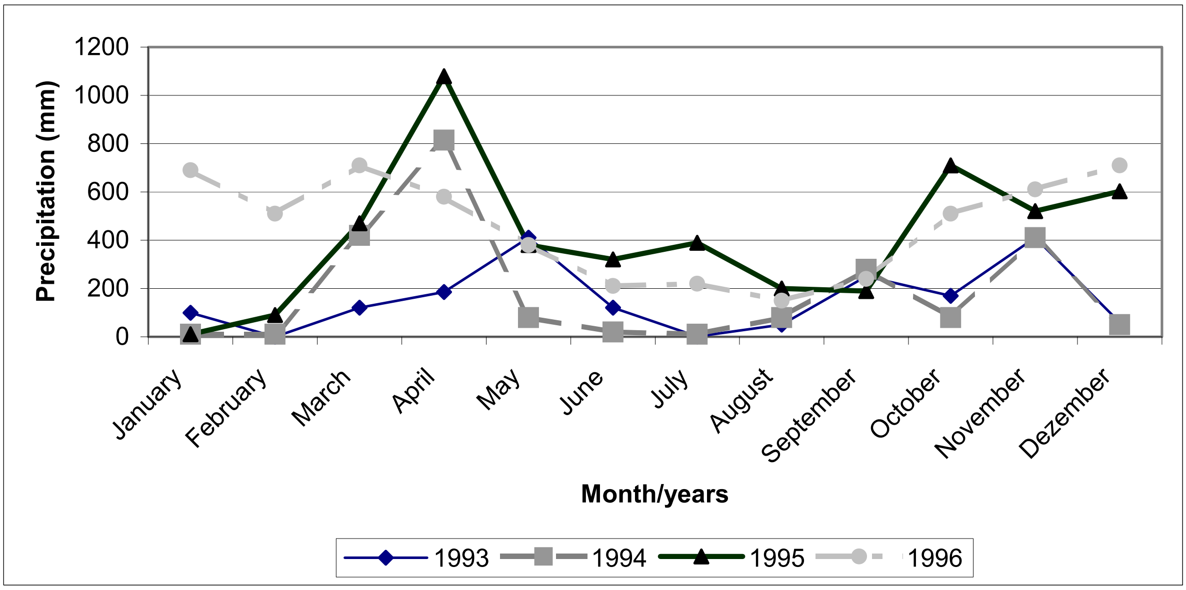
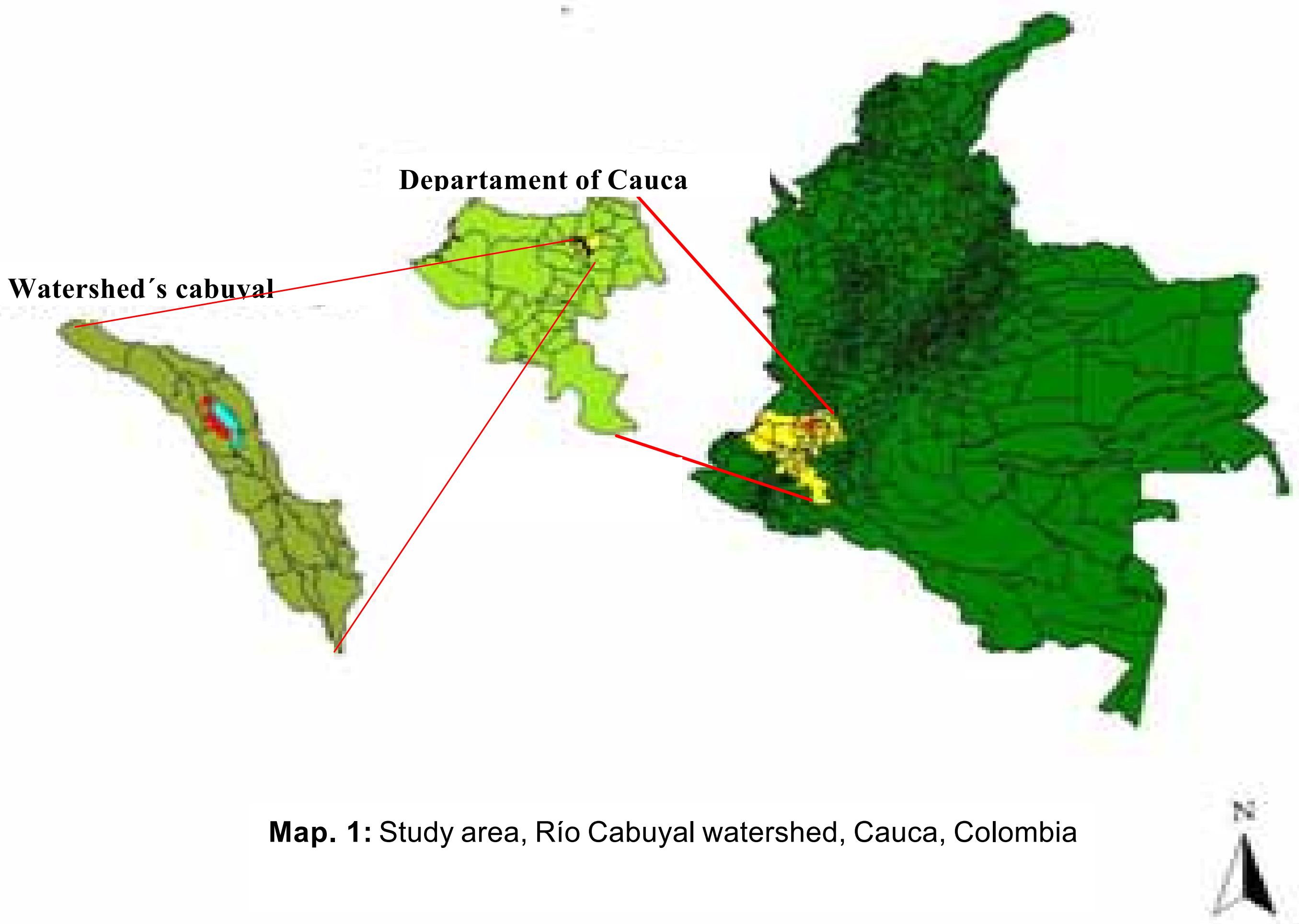


Figure 4: Values of precipitation in the Pescador Cauca (1993-1996).

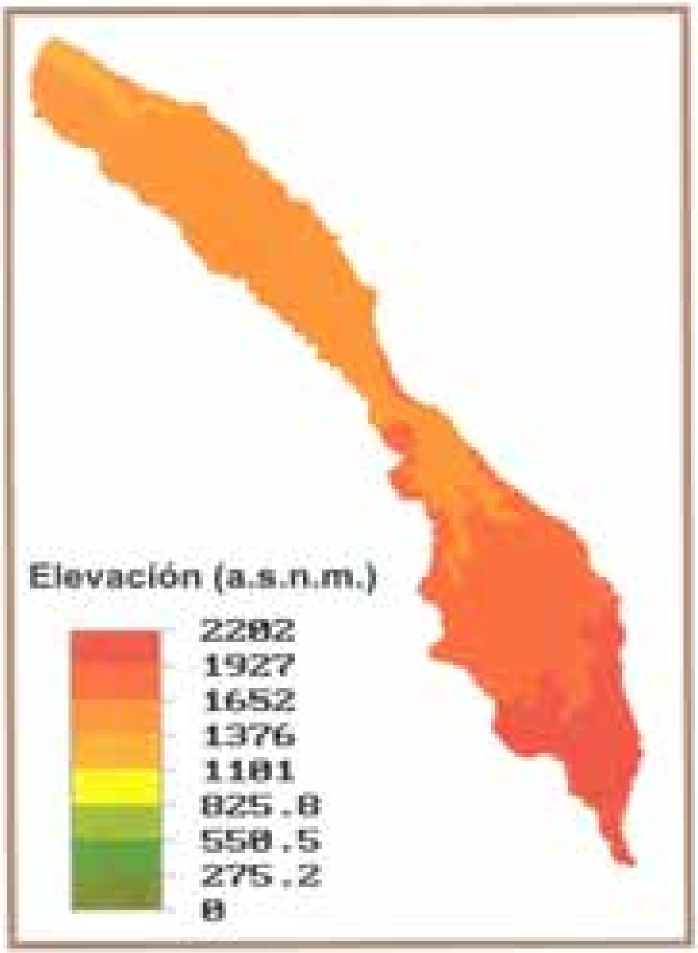
Source: CIAT, 1999.

Study area



Map. 1: Study area, Río Cabuyal watershed, Cauca, Colombia

The monthly average temperature is 19 °C, the temperature ranks oscillate between 24°C during the day, to 17°C at night, with small variations during the year. The annual rate of potential evaporation varies of 1306 to 1106 mm (Ceron, 2001)



Map 2: Elevation in Cabuyal. Source CIAT 2000

The Cabuyal subriver basin is divided in three agro-ecological zones: high, medium and low, related to their position along the Cabuyal river. The low zone covers the biggest area of the microwatershed and has the lowest density of population. (Castano, 1996). The medium zone is the densest area of the region. The coffee is the main culture in the high and medium zones. Cassava is the main crop in the low zone. Pastures and Cassava are important in the high zone, beans are important in the medium zone, and the sugar cane is a major crop in the low zone. (Table 5)

Table 5*:* Characteristics of the Cabuyal microwatshed zones

Village	Zone	Characteristics
El Oriente Buenavista La Esperanza La Primavera El Rosario El Cidral	**High**	Altitude: 1700-2000 m Climate:Cold Soil Type: farallones Usenda Area 2,216ha Population 1211 Density: 56 inh/km^2 Farm area/person: 0,72 Ha. Crops Coffee x platain, fiber, cassava x bean, cassava x maiz
La Laguna Sta Barbara El Porvenir Las Ventanas Crucer Pescador Pescadior Panamericana La Campina Potrerillo	**Medium**	Altitude: 1500-1700 m Climate: Temperate Soil Type: Usenda Pescador Suarez Area: 2375 ha. Population: 2307 Density: 97,1 inh/km^2 Farm area/person: 0,55 Ha. Crops: Coffee x platain, cassava x bean, Pastures, bean.
Palermo Cabuyal Rel Socorro La Isla El Caimito	**Low**	Altitude: 1175-1500 m Climate: warm Soil Type: Suarez, Pescador Area 2775 Population 11886 Density: 60,8 inh/km^2 Farm area/person: 0,74 Ha. Crops Cassava, pastures, cassava x bean, fruits, tree.

Soil types : Farallones= tipyc humitropept ; Pescador= Oxic dystropept, Suarez= ustic dystropept ; Usenda= typic dystrandept.
Source: Rubiano (CIAT)

3.2 Vegetation

The zone of life, according to the classification of Holldrige, corresponds to the ecological formation of Premontano humid forest (bh-p.m.) and following Cuatrecasas (1989), it is an Andean forest. The arboreal layer according to Diago (2000) is constituted by forests of secondary type with trees of little species with heights greater than 20 meters. The main species are: *Ladenbergia oblongifolia* (Rubiaceae). *Cupania latifolia* (Sapindaceae), *Schefflera morotononi* (Araliaceae); the subtree layer is constituted by *Lacistema aggregatum* (Lacistemataceae), *Cinnamomun cinnamofoliumn* (Lauraceae) *Myrsine guianensis* (Myrsinaceae). The Shruby layer is constituted by *aurantiadora Ocotea* (Lauraceae), *Meriana speciosa* (Melastomatecea), *Henrrietella cf. goudotiana* (Melastomataceae) and *Toxicodendrum striatum* (Anacardiaceae).

3.3 Geology

Geologically the zone is part of the Popayan formation. This formation shows three types of materials: acid lava, contributed by the volcanos Puracé and Sotará; layers of volcanic material deposited by drag and, fine materials deposited in the surface, constituted especially by ashes transported by the wind and the water (IGAC, 1976) Geomorfologically, the microriver basin is part of the hillside high plateau, that extends from Santander Quilichao to Popayán; a hillside relief appears with short and strong slopes (IGAC, 1976), (Pallaris, 1999) considered that 86% of the area of the microriver basin present smaller slopes of 15 degrees, 13 % slopes between 15 and 30 degrees and 1% slopes of more than 30 degrees.

3.3.1 Soil associations (IGAC,1976)

Reining (1992) classified them as Inceptisol (Oxic Dystropet), but they happened to be oxisols (Plinthic Kandiox), according to the U.S. Soil Conservation Service.

In agreement with the results of the Colombian Geographical Institute IGAC (1976) for the surrounding area, (Reining,1992) throught of the Mondomo soil as an Inceptisol (Oxic Humitropept). Generally the soils in the watershed, including the specific soil association studied, are derived from volcanic materials (Andosols) that are known to have relatively much higher carbon contents than soils from other parent materials

(Sombroek *et al.*, 1993). This has been attributed to strong bonding between the carbon and the amorphous mineral phase resulting in much reduced decomposition rates. (Knapp and Buitrago 1998)

3.3.1.1 Silvia asociation (Typic Placandept): Heights between 2,000 and 3,000 m.a.s.l. The parental material is ash-gray volcanic. Generally greater strong slopes of 50%. Steep relief. Soils with a high to very high CEC (Cation exchange Capacity). It is poor in total bases and usable phosphorus; hard to moderately acid, deep to very deep soils. Good natural drainage; slight erosion to moderate. Soils operated with subsistence agriculture and cattle ranch with grass kikuyo, yaragua, natural grass.

3.3.1.2 Pescador association (Oxic dystropet): It is located in to 1.800 heights. Parental material is ash-gray volcanic. Geomorfologic landscape is short and irregular pending slope 12, 25 and 50 %. Medium and very deep soils, drained well. The fertility level is low.

3.3.1.3 Suarez association (Ustic dystropet). Located in 2.000 m.a.s.l. heights smalle. Parental material made up of sediments of the Cauca formation (arenaceous and lutits), with inclusions of the Popayán formation (rollings, tufas, clays of tertiary) ash-gray volcanic between 25-50%. Fertility very low. Moderate erosion to severe. Cultures of coffee and banana some sectors strubbles and cattle ranch.

3.3.1.4 Usenda association (Typic Dystrandept). Soils located between 2.000 and 3.000 m.a.s.l. Parental material volcanic igneas rocks (andesites) covered by heavy volcanic ash mantles. Texture heavy frank to fine frank; drained well; Cation exchange capacity (CEC) is very high; to regulate in total bases; very poor of usable phosphorus.

3.3.1.5 Farallones association (Typic Humitropet). Parental material made up of igneas rocks volcanic covers partially by volcanic ashes. Soils with CECe very high, poor in total bases and low in saturation from bases, to moderately acid.

3.2.1.6 Alsacia association. (Oxic Dystrandept). Soils of the disect plain of the Popayán formation. Derivates from volcanic ash, medium to moderately deep and drained well, relief very waved. Low fertility by the high percentage of aluminum.

3.3.1.7 Dominguito association. (Ustic Placandept). Located in low hills. Soils developed from basic igneas materials. They are medium to heavy, deep good drained and of waved relief, soils of low fertility and with clear evidences of critical erosion. (IGAC,1976)

Map. 3 Association soils in the Río Cabuyal watershed

3.4 Chemical soil characterization (Table 6)

Among the chemical characteristics of soils, there is a strong tendency to acidity and poor in nutrients, mainly in bases of interchange and phosphorus. In an investigation of soils of Cabuyal, (RIVAS, 1999) found an average of pH between 4.9 and 5 low contained phosphorus (Bray II) between 2.1- 6.8 ppm, low in calcium 0.94-1.45 (meq/100g), and magnesium 0,3-0,4 (meq/100g) high percentage of aluminum saturation 42-55%, organic matter between 7.9-12.8%, effective Cation exchange capacity CECe 3.6-4.1 (meq/100g).

Table 6: Values averages of nutrients of soils by zones of the river Cabuyal, watershed, Cauca Colombia (1970-1999)

Nutrients		Zones	
	High	**Medium**	**Low**
pH	4,91	4,86	5,34
Al (meq/100g)	1,49	1,38	2,06
% Sat. Al	42,35	42,24	55,08
M.O.	12,8	9,64	7,94
P (ppm) Bray II	6,84	3,92	2,21
Ca (meq/100g)	1,45	1,29	0,94
Mg (meq/100g)	0,47	0,41	0,36
K (meq/100g)	0,35	0,36	0,22
CECe (meq/100g)	4,19	3,44	3,6

Source: Rivas 1999

On Biology of soils of Cabuyal, Feijoo (2000) raises that the introduction of grass *Pennisetum clandestinum*, *Melinis minutiflora* and *Brachiaria humidicola* and of species *Pinus patula* and cultures, such as the coffee, the maniok, bean and maize, diminish the diversity of organisms and when the ecosystems are modified, some organisms resist the disturbance, whereas in other occasions the original populations disappear and the habitats are colonized by cosmopolitan species. (Feijoo *et a*l, 2.000)

3.5 Land use and vegetation

The use of land is classified in the following categories: (See Map 4)

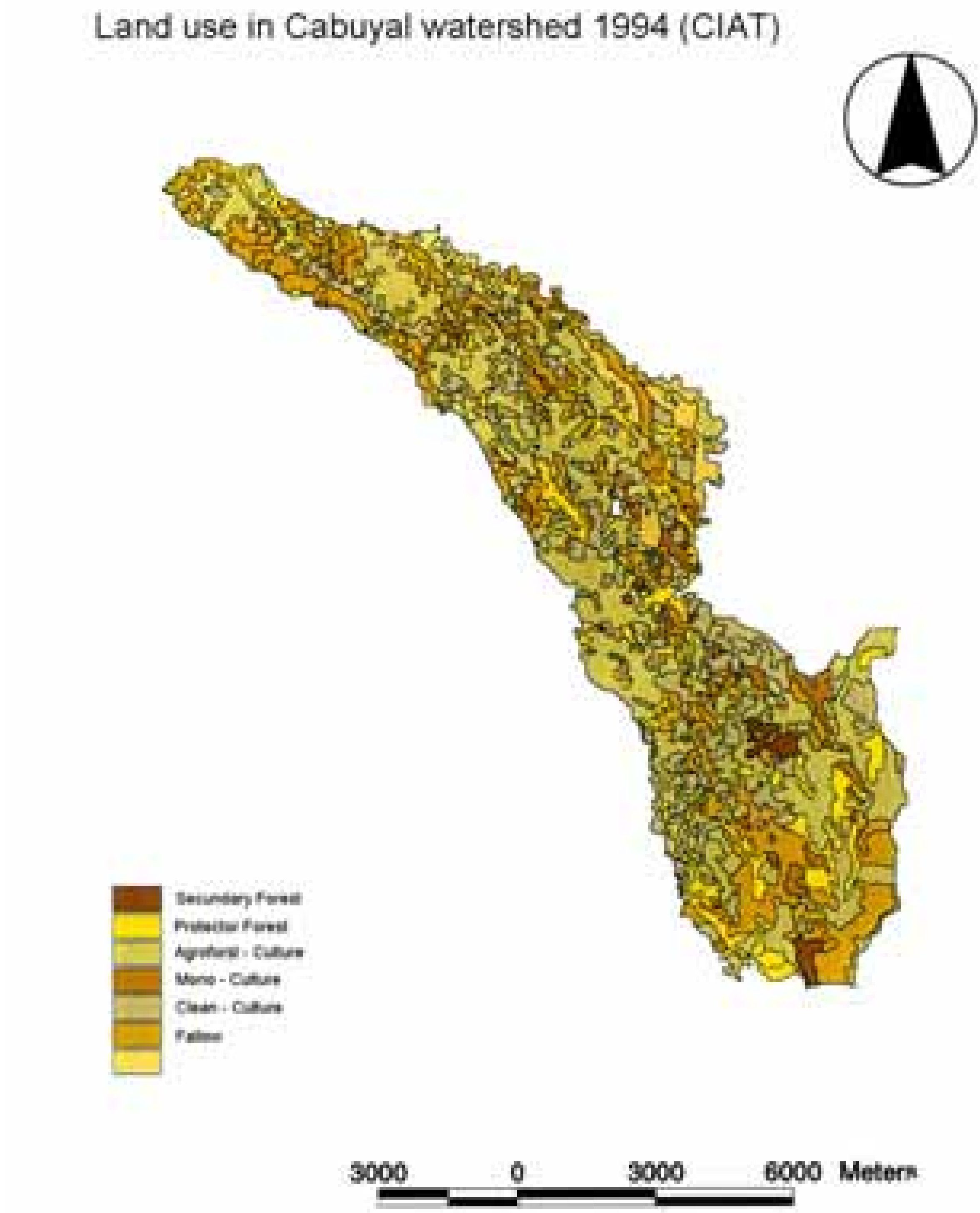
- Forests
- Grass
- Cultures
- Fallow.

The distribution of the land use in the Cabuyal river watershed is constituted by local and forests, agriculture, cattle ranch, highways, roads. This can be appreciated in Table 7. and Fig. 5

Table 7: Percentage of the land use, with respect to the slope

Slope	Protection Forest	Forestation	Dense Cultivation	Cultivation with semi-weeding	Cultivation without weeding	Clearing land	Fallow	Total
<6%	2,6	1,1	53,5	16,7	3,7	3,2	18,9	100%
6-12%	4,2	1,6	53,5	12,0	3,5	4,3	20,6	100%
12-30%	7,2	2	47,9	8,9	2,8	3,6	27,5	100%
30-70%	8,8	2,2	36,1	2,5	5,1	3,3	42,0	100%
>70%	9,5	1,3	27,3	3,2	1,5	2,6	54,5	100%
Total average	6,46	1,64	43,66	8,66	3,32	3,4	32,7	100%

Source(Knapp et al 1998)


Land use in Cabuyal watershed 1994 (CIAT)
Secundary Forest
Protector Forest
Agroforst - Culture
Mono - Culture
Clean - Culture
Fallow
3000
0
3000
6000
Meters

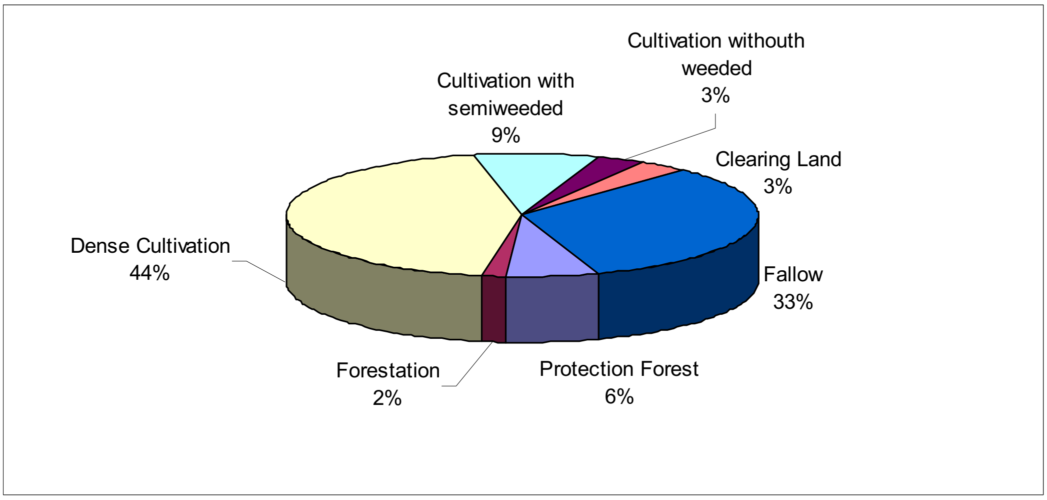


Figure 5: Porcentage of land use in Cabuyal watershed
Source: CIAT 1995

3.6 Agroforestry System

The vegetation of fallow endures between 1 to 3 years and has seeds pertaining to the following sorts: *Pteridium, Myrica, Mimosipsis, Hypochaeris, Delosma, Hyptis, Sida, Axonopus, Cuphea, Miconnia, Gnaphalium, Rubus, Maryphianthes, Austroeupatorium, Sporobolus, Clidemia, Ayapana, Befaría, Panicum and Rynchospora*.

Dacto and Dorado, (1998) identified the vegetation of the river basin Cabuyal, and found that the agriculturists have three different agroforestry-systems represented:

1. Agroforestry systems.
2. Live fences.
3. Wind shields.

The agroforestry systems are of three types: Trees associated with perennial cultures, family garden and silvopastoral systems. The trees associated with cultures consist in associations of coffee, banana, and sugar cane. The main trees associate are the guamo *Inga sp*., jigua, *Nectandra sp*., nogal cafetero *Cordia alliodora*, cachimbo *Erythrina poeppigiana,* aguacatillo *Cinnamomun sp* y aguacate *Peresea americana*. The trees have medicinal, combustible domestic use, wood for furniture, construction of house, fences and utensils.

The family gardens are frequent in all the Cabuyal river basin. They are set up around the house and have a complex vegetal composition in which there are forest species and cultures. The main culture trees are the mango, *Mangifera indicca*, naranjo *Citrus sinensis*, naranja lima *Citrus aurantifolia*, níspero *Eryobotria japonica*, guayaba *Psidium guajava*, papaya *Carica papaya*, pomarroso *Sizygium jambos*, chirimoyo *Annona cherimolia*, gauanabano *Annona muricata* y guamo *Inga spp., t*hat they are associate to the coffee, banana vegetables, medicinal plants. The arboreal species are used as combustible and food.

The silvopastoral systems predominate in the high part of the Cabuyal river basin. They are small systems where there are forest species as the cascarillo *Ladenbergia oblongifolia*, jigua Nectandra sp., mandur *Vismia lacuis*, arrayán *Myrcia popayanensis* and roble *Quercus humboldtii* asociate with grass as kikuyu *pennisetum clandestinum*, estrella *Cynodon plectostachyus*, yaragua *Melinis minutiflora*, imperial *Axonopus scoparius*, braquiaria *Brachiaria sp* and gramma *Paspalum sp*. The trees are used to provide shady, wood for construction and fuel.

With respect to the agroforestry systems of life and wind shields, they are planted in the middle and high parts of the river basin; in the paddock, cultures, ways. The species used are: Pino, *Pinus patula*, urapán *Fraxinus xanthoxyloides*, eucalipto *Eucaliptus sp.* Y guayabo *Psidium guajava.* The trees are used to define limits between the property; protection against the wind of grass cultures and cattle; protection of the soil; forage; wood; fuel; fruits and medicinal (Diago, 2000).

3.7 Characteristics of peasants in Cabuyal Watershed

The table 8 describes the typical farmer in Cabuyal: male, 47 years old, with three years of education. He owns the farm, possesses three crop fields, and works mainly on farm. A typical farm possesses five plazas (3,2 ha.) of land, planted predominantly to a variety of crops, though small areas of pasture and fallow also exist.

Table 8: Characteristics of farmers in the Cabuyal microwatershed

Farmers characteristics		
Age		47 years old
Sex	Male Female	80.7% 19.3%
School completed (years)		3
Percent of families per household	1 2 3	92.2% 7.1 % 0.5%
No. of persons per household	-----------	4.7
Percent of farms per owner	1 >2	86.3 13.2
No. of field per farm	----------	3

Sources: Cabuyal census. Zit. Castano

Coffee (intercropped with plantain and fruits) and cassava (alone or associated with bean or maize) are the most important crops in the Cabuyal zone. Other crops are beans, cane, tomato, fiber. Coffee and cassava are widely cropped in the region because, once they are installed, they demand little work and investment, compared to crops like bean, and vegetables. For coffee and cassava, the weeding only has to be done twice. In addition, cassava does not require spraying or fertilization. Sowing of crops, such as bean, maize, peas, coffee and sugar cane, is mainly done in the rainy months of September and march. Vegetables and cassava are sown throughout the year. (Castano, 1995).

Infrastructure is poor in Cabuyal. There is only one paved road which crosses the narrowest part of the region. During the rainy season, pick up vans and buses are common forms of transport, with passenger fares within the microwatershed being 33% more than cost of a pound of rice. Horses are used in remote areas.

A number of organizations work in the microwatershed, but most of them are oriented towards production or conservation. In a participative diagnostic study, done in the Caldono municipality (1993), marketing problems, such as high price fluctuations, lack of credit service and infrastructure (roads energy), high input prices and unavailable marketing channels, were identified by farmers as the main problems after the agronomic aspects. As solutions, farmers proposed to stimulate farmer organizations in order to establish cooperatives and storing centers. (Castano,1995)

However, cash availability remains a serious constraint, and farmers expressed the need for more reliable market information.

The Western concept of unconcern of agriculturists for the land, from a cultural perspective of agriculturists, is not valid, because intrinsically they think that the land is conserved. More than a technical problem it would be a cultural problem. (Rivas, 1999)

4. Field and Lab Methods

4.1 Taking and analysis of data

It is a region of small agriculturists who cultivate the following crops: coffee, bean, cassava, corn, fruit trees, grass, cows.

The research was made with 47 farmers of the basin of the Cabuyal river, the criterion to choose them was its level of participation and interest in research programs of new technologies with the advising of ONG like for example: CIAT; ASPROME, CETEC, CIPASLA, etc.

The field work was divided in five parts:

4.1.1 Informal visits to the agriculturists.

The field work was initiated in June of 2001 and extended to more than 7 months until February 2002. It was carried out with the agriculturists who inhabit the microriver basin of the Cabuyal. The microriver basin was selected as study unit because it is feasible to frame the physical limits and works on the assumption that the effect of changes in the land use can be measured through the monitoring of the quality of the water. Initially, the farmers were approached with the following three objectives related to the investigation: a.- To expose to the agriculturists the objectives of the investigation. b.-To generate confidence and approach between the investigating external agent and the local community, the agriculturists. c.-To have other potential agriculturists, recommended by the farmers, in the investigation.

4.1.2 Accomplishment of survey and interviews.

The farmers' knowledge was recovered through surveys or semi-structured interviews about the farming production and its relation with the resources (soil, water, forest). The use of the semi-structured interview is based on the flexibility to come near the agriculturist. This type of interview is characterized previously by the flexible development of subjects selected in listing forms, where the interviewer fixes the sequence, the order, the form and the type of question that arises in a while from the dialog with the agriculturist.

Table 9: Subjects of the survey

1. Basic information: • Area • Georeferency· • Land possession
2. Land Use: • Plantation· • Grass • Fallow
3. Agroforesty system
4. Characteristics of the soil • Color • Slope • Macroinvert • Texture • Yield
5. Local Indicator of quality soil: • Color • Matter Organic • Fertility • Texture· • Yield
6. Development of the soil according to agricultures. • Improvement· • Erosion
7. Conservation of the soil
8. Indicators Plants

Allowing that the surveyed person expresses itself freely with historical memories, evaluations. This unmannerliness allows a better adaptation of the survey to individual circumstances to be more efficient.

The survey was called: "Evaluation of the quality of soil from the agriculturists of the Cabuyal River basin". It is summarized in the following (Table 9 and appendix 1)

The survey was processed to make the main analyses of descriptive statistic, for example normal distribution, frequency, of the following variables: Land use, main indicators of soils quality, evolution of the horizon A, practices of soil conservation, plants as indicator of good soil, plants as indicator of bad soil.

Later a correlation of variables was made to see if they are variables employed independently and with its respective analyses of variance.

A matrix of correlation, based on the survey, was established to obtain 36 variables. For the three different statistic analyses, the program SAS was used. Two simple correlations, the Spearman test and the test of Pearson, and furthermore the test of partial correlations, soon selected the variables that are interdependent. Later one, the variables with a higher coefficient of correlation, having as fundamental criterion the land use, were prioritized.

Testing the classification: To test the validity of the indigenous classification as tool for objectively grouping soil, a set of chemical soil parameters, was analyzed by clusters (Queiroz, 1991). The composition of the numerically derived clusters was then compared with the grouping of soils in accordance with the indigenous classification. The chemical soil parameters and the local classification was assessed by evaluating the association between cluster membership and three key soil parameters: Carbon, Aluminum and CECe.

Cluster Analyses:

As most soil data collected in the field are multistate variables, coding of attributes was necessary. This approach is discussed by Sokal and Sneath (1963), and was successfully applied by Cipra *et al*., (1970) to analyze soils by cluster.

4.1.3 Maps and distribution of the farmers.

Participatory mapping is a technique that proves very useful for agriculturists. This is perhaps more the case with semi-extensive and extensive systems than with intensive dairy systems, but maps can also be used to explore fodder resources, marketing, input supply and service provision linkages. (Morton et al 2002).

The property of the agriculturists was mapped, in order to include the space distribution of the cultures, the slope, location of best land, location of the indicating plants of quality soils, location of the house, etc. (Appendix 2). The maps are an important tool of the Fast Rural Diagnosis which allow an updating of the present land use.

4.1.4 Taking of soil samples.

4.1.4.1 Samples of soil

There were gathered six different samples of soils, to a depth of 0 to 20 cm for a total of 255 samples, in 47 properties. Each site was georeferenced with a GPS (Global Positioning System), and for the taking of samples the so-called drill soil: Göttingen bohrstock, was used. The soil samples were placed in plastic bags to be analyzed with the methodology of the laboratory of CIAT, which evaluated the following chemical parameters: pH, total carbon, phosphorus (Bray II), aluminum, magnesium, calcium, potassium, bases of Interchange (Appendix 3). For the physical soil analysis, texture and structure were evaluated.
The criteria for the taking of soils samples were:

1. That they should represent the different land use types in the river basin.
2. According to the local criterion of the farmers, to identify and differentiate the land , the following 8 types of land were identified: Tierra Brava, falda, cansada, coffee plantation, forest, Loma huecada and zanjón. This type of land use can be considered for the statistical test of the treatment. According to the agriculturists, the group of good soils includes: forest, coffee plantation, huecada and zanjón; Soils of intermediate quality are those of hills with pastures. The group considered of smaller quality is: Brava, cansada and falda. (see Table 10).

Table 10: Classification: Different use of land by peasants, Cabuyal, Cauca Colombia

Local name	Location	Land use	Clasification
Brava	Hillside	Fallow	Bad
Cansada	Hillside	Fallow and Maniok cultivate	Bad
Falda	Hillside	Pasture	Intermediate Quality
Loma	Top	Pasture	Good
Forest	Hillside	Secondary Forest	Good
Coffee cultivate	Hillside	Coffee agroforestry	Good
Huecada	Confluence of two colines	Coffee agroforestry	Good
Zanjón	Border of the river	Natural Fallow	Good

Course: Rivas 2001

4.1.4.2 Data bank of soils

To analyze the behaviour of the soil's fertility, judging by the main chemical soil indicators, I got access to the bank of soil analyses of the Secretary of Agriculture. They have more than 3.500 soil samples, distributed in the watershed during the last 30 years.

With the help from the program S.A.S., different proofs or statistic analyses were carried out for the three different zones (high, medium and low). The following tests were made: "T", Chi^2, ANOVA, frequencies. While observing significative differences of the main parameters, the tendencies of the different zones were drawn, as well as the behaviour and evolution of each parameter during the last 30 years. For the drawing, the program Sigma Plot and Excel were used. (Appendix 4)

4.1.5 Taking of plant samples as soil indicators.

The agriculturists informed that the plants are valid indicators to evaluate the quality and fertility of soils. Thus they provided more than 50 species of plants.
For the sampling, wooden boxes of 1m x1m were used. They were placed on the terrain of research to determine abundance and diversity of weeds.

As the parcels were small, they were grouped according to types, and counted in the following way:

- To estimate the minimum number of boxes per parcel, the minimum representative area was calculated in the following way: The first way across the parcel is done in Zig Zag, samples are taken, counting only the number of species. From the second way on with the boxes, new species are registered and these are the ones which indicate the representative species of the weed population.
- To count the plants, the box is subdivided into four parts with a rope to relieve the counting.
- In case of not knowing certain species, they are given a number of identification on the data sheet, and their individual plants are counted as well.
- Once the minimum number of required boxes is estimated, the samples are distributed by chance in Zig Zag across the parcel, and the species as well as their number are registered in the data sheet.
- Afterwards, the relative frequency = number of parcels in which the species x 100/ total number of parcels, is calculated.
- Finally, the relative abundance = number of individuals of each of the species x 100/ total number of counted individuals of each specimen of each parcel.

The botanic data collection was done collecting samples of each species of plant in the property of the farmers. The samples were classified by the techniques for laboratory of taxonomy plants with the following steps:

- The plant is wrapped in paper within the wood press to take it to the stove for its drying process
- The samples were sent to the laboratory of National University in Palmira called Jose Cuatrecasas Arumi, for its botanical identification.
- Soon the samples were placed on a cardboard to be labeled and filed.

A revision of literature was made on each species found as indicator of soil quality, with data on the different cycle of life and its adaptation to habitats. In addition to the other uses of the plants: medicinal, forage, protection, etc.

The main subject of the survey and the interviews with the agriculturists was the use of the soil, main morphologic characteristics to recognize a soil, main criteria of the agriculturists to evaluate the quality of its soil from its local knowledge, development and evolution of its soil from its observations in the last 20 years, main indicating plants of soil quality. 300 samples were taken of soils and approximately 50 samples of used plants as indicators of soil quality by the agriculturists, for taxonomic classification and recognition.

4.2 Technique used in the chemical soil analyses.

4.2.1 Organic carbon.

The modified procedure of Walkley is used (1934), which is based on humid oxidation, to determine the content of organic Carbon in the soil. The sample in a potassium dichromate solution oxidizes, using the heat produced by the concentrated sulfuric acid dilution:

$$2Cr_2O_7^{2-} + 3C + 16H \rightarrow Cr^{3+} + 3CO_2 + H_2O.$$

The produced chromic acid can be measured for colorimetric system to a wavelength of 620 nm. It is assumed that the organic mater contains 58% of Organic carbon and the factor is used of Van Bemmelen of 1.72 to consider the organic matter.

4.2.2 Exchangeable cations.

The exchangeable cations include the Ca, Mg, K, Na (basic cations) and in acid soils also include the H and Al (the interchangeable acidity).

4.2.3 Calcium.

The Ca cation moves with a potassium chloride solution no cationic (1M). The concentration of each cation in the extract by atomic absorption to quantify.

4.2.4 Potassium.

To move exchangeable potassium in the soil, an ammonium chloride solution (1M) can be used, or the solution of Bray II (HCl 0.1 M and NH4 F 0.03M), which is used to determine phosphorus in the soil.

4.2.5 Exchangeable acidity

(Al and H). 50 Milliliters of the extract obtained with KCl 1 M is transferred in an Erlenmeyer of 125 milliliters. Later add 3 drops of fenolftaleina 0.05 M is titled with NaOH until the appearance of a permanent is of pale pink color. This is deduced by the milliliter of NaOH used in the titulation.

4.2.6 Percentage of Aluminum Saturation.

Another average of the acidity of the soil is the percentage of the Aluminum saturation of the CECe. Estimation that is used as simple indication of the chemistry and the potential fertility of the soil:

% Saturación de Al= Al/ Ca + Mg + K + Al + * 100

4.2.7 Effective Cation Exchange Capacity (CECe).

The exchangeable cations including Al, move with a salt no cationic, and the CECe is taken as the sum of cations in the extract.
The CECe is expressed in meq/100 g

CECe = Ca + Mg + K + Al…

4.3 Color

The table standard's color of Munsell was used. In agreement with Torrent (1983) and Thompson and the Bells (1996).

4.4 Texture

40 grams of dry soil are mixed with 50 milliliters of solution of hexametafosfat of sodium and sodium of carbonate. After 10 minutes, the samples are placed in ultrasound during two minutes by 30 r.p.m.. They are placed in metallic receptacles, adding water to them and shaking them in a multimixer during 10 minutes. In a test tube of 1000 milliliters, which was completed with water of moderate temperature, the samples were shaken during 40 seconds and every 20 seconds they were moderated with a hygrometer. Two hours later the second measurement was made. The correction of humidity is obtained with 5 grams of dry soil to 105° C.

% Sand = 100- Lc40" x 100/ Mss

% Clay= Lc2h x 100/ Mss

% Silt= 100-(% Sand+% Clay)

Lc 40": Measurement of hydrometer 40" with Correction of temperature (24°C+1.64)
Lc2h: Measurement 2 hours with Correction of temperature.
Mss: Sample of dry soil.

5 Results and Discussion

Toda nuestra manera de vivir tiene que compenetrarse por una cultura de responsabilidad. Sin embargo, la universidad tiene una función especial por el hecho de que una cultura no se puede desarrollar, si no está acompañada por pensamientos profundos, que hasta hoy han tenido su lugar más destacado en las universidades. Esta cultura de la responsabilidad, por supuesto, es crítica. Pero el acento no está en la crítica, sino en la responsabilidad, que exige ser crítico. También la cultura de responsabilidad lleva a la resistencia. Pero, otra vez, el acento no está en la resistencia, sino en la responsabilidad. Por eso el hecho de que es la res ponsabilidad la que lleva a la resistencia.(Hinkelammert F.)

5.1 The Peasants

In the present investigation the term "production unit" is used to determine lands belonging to a peasant or proprietor, without being at the same time their home. The reason for this is that many proprietors don't inhabit the area of study permanently. Thus for example on the total of proprietors 57% live in the microriver basin; 16% are proprietor of lands, whose house is not here but in other estates close. 10% live in other regions, generally of the department of the Valle and the "production unit" is left in charge of his workers. 9% are absent and single, 7% have a house, but no land to work.

5.2 Land Use

The zone of study presents that 52.8% are dedicated to cultures, 10.1% to pastures, 14.9% to forests and 21.9 % are fallow without vegetation cover.

Table 11. Land use-types in different zones of Cabuyal 2001

Land Use	**Level**			
	Highest Level	**Middle level**	**Lowest level**	**Mean**
Crops	46.2%	55.8%	58.70%	**52.8%**
Pasture	14.7%	9.50%	4.20%	**10.1%**
Fallow	20.4%	22.30%.	23.70%	**21.9%**
Forest	18.5%	12.20%	13.20%	**15.0%**
All	100%	100%	100%	

Source: Own sourvey

In table 11 it can be observed that the medium and low regions present a higher percentage of soil usage for cultures, with 55.8 % and 58.7 % respectively, than the high zone. For this reason, there's more laboring of this soil, from which a greater risk of erosion can be deduced.
Concerning the conten of organic matter, the graph 8 shows that nthere's major content of it in the hight zone, in comparison to the middle and high zones. In the high zone there's a greather percentage of Forest area, with 18.5%

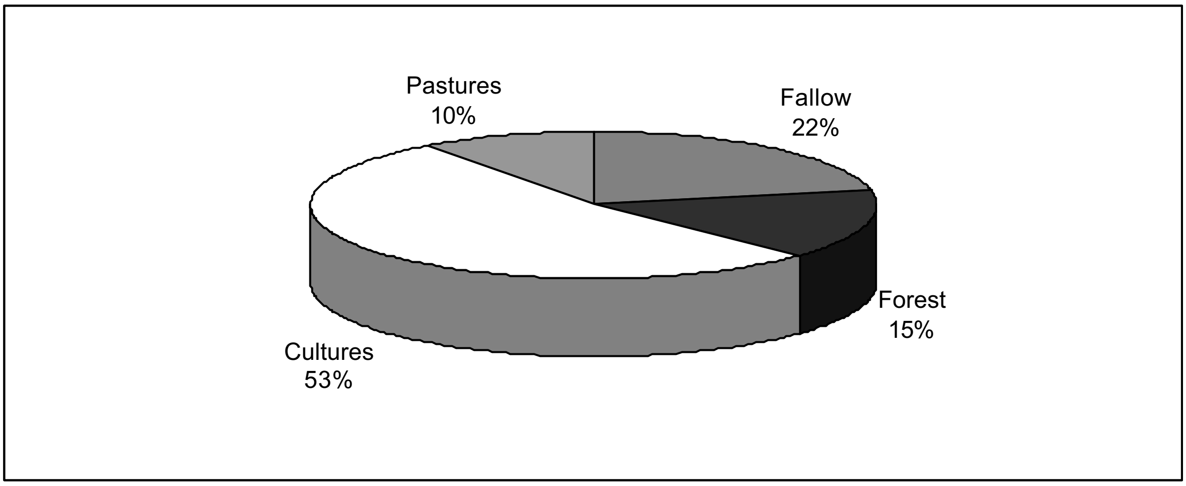


Figure 6: Estimation land use in Cabuyal 2001

5.2.1 Cultivations

The peasants of the watershed´s basin cultivate Coffee *coffee arabiga*, banana *Musa spp., Manihot esculenta*, mayz *Zea maize*, red beans, *Phaseolus vulgaris*, tomato *Lycopersicum esculentum, Sacharum officinarum*, *Capsicum annuum*, fruits trees for example: Guamo *Inga spp*., papaya *Carica papaya*, the lemon *Citrus lemon*, the orange, *citrus sinensis,* the banana tree *musa spp.* The mandarin C*itrus nobilis*, avocado *Persea americana*, the *Mangifera indicates*, guayaba *Psidium guajava*, the nispero *Eryobotrya japonica* and caimo *Caimito pouteria*. The fruit trees serve to give shade to the coffee as an agroforestry system that allows to protect the soil, regulating the cycle of water and nutrients. (See Table 12)

The forest species we have are: cachimbo *Erythrina spp*, nacedero *Trichanthera gigantea*, cascarillo *Ladenbergia oblongifolia*, cucharo *Myrsine guianensis*, jigua *Nectandra macrophylla*, the mestizo *Clethra fagifolia*, the pomorroso *Syzygium thieves* and uvo *Ficus spp.*

The peasants have perennial and transitory cultures. The coffee culture is most important in the region for economic reasons as well as due to its extension. 93% of the peasants grow coffee; The more important varieties of coffee are the Arabic variety and Caturra variety. In the last five years the coffee with tree species has been cultivated for commercial use. These are for example papaya, *Carica papaya*; platano*, Musa spp*.

The peasants show that the coffee with shade supports: the use, the humidity, the amount of shade, the association with insects, the leaves and the root. For example the peasants affirm that the trees of guayaba, avocado and cascarillo compete for humidity in the culture of coffee. for that reason do not leave these abound much. The following trees are preferred best because they contribute good organic matter and don't let grow the grass: Guamo, *Inga side*; the nacedero *Trichantera gigantea* and cachimbo *Erythrina spp*. The banana, *Musa spp.* The trees used to give shade within the agroforestry system of coffee improve the physical and chemical conditions of the soil. Thus for example, cultures of Erythrina spp, used as a tree giving shade in Costa Rica, is a convincing example for the beneficient effect of trees fixing nitrogen, as they provide about 130 Kg N /Ha/year (Ramirez *et al.,* 1990).

Referring to the corresponding amount of land dedicated to agricultural products, it is estimated that the 36.8 of the agricultural area is for coffee culture; 9.1 % for bean; 7.7% for fruits; 6.4% for maniok culture; 3.0% for maiz ok and 2.4% for cane, (See Fig 7)

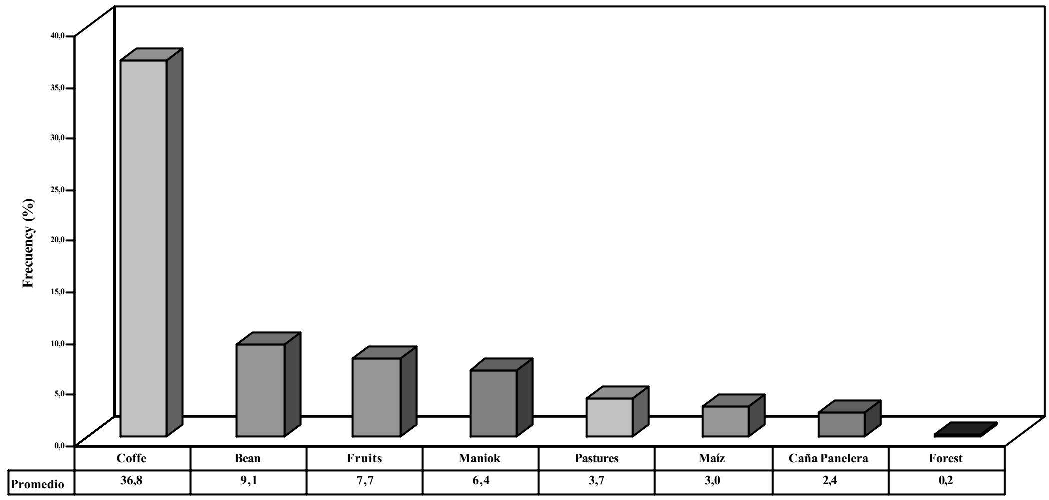


Figure 7: Hierarchies position of the cultures in zone of study

Table 12: Preference of shady in the culture of coffe. Estimation of the peasants of the river basin of Cabuyal 2001**.**

Name	***Botanical estimation***	***Advantages***	***Disadvantages***
Avocado	*Persea americana*	Fruits	Much roots. It competes for water
Cachimbo	*Erythrina spp.*	The leaves are good Manure. They conserve humidity	
Cascarillo	*Ladenbergia oblongifolia*	Combustion	Much roots. It competes for water.
Cucharo	*Myrsine guianensis*	Humidity. Wood	Much roots
Drago	*Croton funkianus*	Medicinal	
Eucalipto	*Eucaliptos sp.*	Wood	It competes for water
Guadua	*Guadua angustifolia*	It protects the water. To sell	Much roots
Guayaba	*Psidium guajava*	Fruits	Much roots
Guamo	*Inga vera*	The leaves are good Manure. They conserve humidity. Excellent for cafe	Low density
Nacedero	*Trichantera gigantea*	The leaves are good Manure. They conserve humidity	
Mestizo	*Clethra sp.*		It competes for water
Platano	*Mussa sp.*	Good shade. It protects the water	
Pino Roble	*Pinus patula* *Quercus humboldtii*	Wood	It competes for water
Uvo	*Ficus sp.*	Humidity	Much roots
Yarumo	*Cecropia sp.*	Humidity,	it attracts ants

Source: Rivas 2000

5.2.2 Pastures

10% of the area are dedicated to pastures. Only 28% of the peasants have pastures with prairie and 6% have cut grass. The pastures are relatively small: between 1 to 4 hectares in average.

5.2.3 The fallow area

It is considered that the fallow area covers 22% of the land. According to the peasants, a fallow area is left in order to let „the land rest“, and also due to the reason that economic resources and farm-hands are lacking for use in agriculture. The fallow is left for periods between 2 and 5 years. After this period, the vegetation is either burnt or left to disintegration.

Some authors among them Urbano *et al.,* (1996), found out that there is an intense dynamics of changes in the use of the land in the river basin of the Cabuyal. They come to this conclusion after comparing the change of the land use through the time, using photo-interpretation with photos of years 1946, 1970 and 1991. In addition there is a significant relation between the land use, the pending variables, the accessibility and the biophysic criteria. The area of appropriate use has increased and the inadequate use has been reduced existing a relative stability with tendency to improve the use of the soil.

As the methodology of Urbano and the one made in the present study with maps raised by hand are totally different, some general tendencies that are given in the river basin can be proposed: in the tomb system, the peasants grazes and burns is diminished by seedtime of cultures destined to the market.

In the river basin of the Cabuyal the natural forest represents an average of 7% use that has stayed with tendency to increase. Fallow has been diminished, in mere 1970 to 41% and 1991 to 33%.

The semiclean and clean cultures in the river basin of the Cabuyal increased in 1991 to 8.8% and 2.6 % respectively. In the zone of study, this kind of use was estimated to be 32 % and 19 % respectively. Indicating that there’s major proportion, being 18.5% of these semiclean crops. Among the reasons for this change the following ones can be mentioned: the increase of external entrances, the access to market sites, the presence of ONG's, including technical assistance, and loans for the farming activity.

The fallow area is estimated to cover 4 % of the land. According to the peasants, a fallow area is left to let "the land rest", and also due to the reason that economic resources and farmhands are lacking. The fallow is left for periods between 2 and 5 years. After this period the vegetation is burnt or left to disintegrate.

Table 13: Changes in the use of soil in the river basin of the Cabuyal (%)

Land Use	***1946***	***1976***	***1991***
Protective forest	6.43	8.19	7.36
Planted protective forest			1.91
Pasture	50.34	41.34	42.56
Semiclean culture Maniok, Bean, Tomato, Coffe, Lemon, etc.	0.46	2.14	8.84
Clean Culture	0.0	0.0	2.59
Exposed land (eroded zones)	2.95	7.33	3.39
Zones in rest	39.83	40.99	33.34
Total (Ha.)	13431.44	6505.76	7063.42

Source: Urbano *et al* (1996)

5.2.4 Forest

The forested area is constituted by guadua, *Guadua angustifolia* and secondary forest. It is estimated that a 35% of the area of the region are covered with forest and in the last 30 years this has been increasing. The amount of the land dedicated to forest in the property oscillates between 0.5 and 3 hectares. The forest is used for four fundamental purposes: As water protector, to obtain materials of combustion, wood, timber for the local construction or for sale and to use the forests soil for the seed plots.

5.3 Cultivation management

5.3.1 Soil preparation

The agriculturists who live in the Cabuyal zone have few economic ressources and their activities concerning the soil's are not very homogeneous. The crop's treatment differs depending on whether it's meant for local consume or for sale. The latter, which are mostly crops of short cycle, such as red beans, tomatoes, a major investment is done, and they get more time for fertilization, supply of pesticides and maintainment.

The crops destinated for local consume are for example fruits, maize and yuca, which don't require so much pesticides and fertilizer, as these are cultures that allow a better ecological balance between plagues and calamities.

For cultures like coffee, fruits, platano (*Mussa sp*), a hole of 30 cm. of breadth is made for each plant. Now, organic soil is aplicated in the hole, with poultry dung or an organic layer of calfos (Ca). The peasants who cultivate vegetables, make furrows and put the seeds in its superior part. The weeds or the organic residues of the house, are applicated in the inferior part of the furrow. Thus they decompose slowly, supplying the organic matter.

5.3.2 Fertilization

The fertilization depends on the culture and on the economic capacity of the peasant. Each plant of coffee f.e. needs about 300 to 500gr. of poultry dung when it's sown. Nevertheless, some agriculturists manifest that they don't fertilize the coffee right then.

During the coffee's phase of growth and production, 65% of peasants manifested that they do fertilize the coffee crop periodically, while 35% say they don´t. Among the products used to fertilize are: poultry dung, compost, residues of crops, ashes, kitchen refuses and chemical fertilizers, such as urea. (Table 14)

From 47 agriculturists, 40% manifested that the yuca culture wasn't fertilized, while 62% said about 250 gr. of fertilizers per plant were supplied in the moment of sowing the seeds.
In other cases chemical fertilizers were mixed up with poultry dung.

The red bean and the maize-yuca and maize red bean associations, are fertilized with poultry dung. Referring to the maize, about 56% didn't fertilize it, and 46% did.

Referring to the pastures, 63% manifested not to fertilize it, while 37% said they did, twice a year, when the rain period starts. The quantities of fertilizer vary between 100 and 200 kg/ha.

Table 14: System of fertilization by peasants in Cabuyal

System fertility	Fertility	Frecuence
Not fertility		20%
Fertilization	Poultry dung……………………..	45%
	Crops residues ………………..	28%
	Mineral fertilisers……………..	7%

5.3.3 Weeds

The peasants leave the weeds in the paths of the cultures to let them disintegrate and thus serve as fertilizer.
The weeding is done 3 or 4 times a year, especially during dry periods, so that the extension of seeds is assured.

5.3.4 Watering

The peasants only use watering systems for some of their cultures destined to the market, such as tomato or red bean. For these cultures, water is extracted from a river or natural source, and transported with a motor pump.

5.3.5 Barriers

The peasants are conscious about the effect of rain or water as causes of erosion. For this reason they use living barriers. But only 35% of the agriculturists employ this kind of practice, using cultures like cana, vetiver, limoncillo for this aim. They also place remnants of *plátano* vertically to the slope.

The agriculturists affirm that those barriers which provide an income, are better than those without any utility. Thus, for them living barriers like *cane* or *botón de oro* are at the same time a nutrient source for their familiy or for domestic animals.

5.4 Land use and chemical soil indicators

Table 15: Chemicals Parameters of soil in three differents land use of cabuyal 2000

		Land use	
	Forest	Coffee Shady	Cassava
Carbon (%)	10	8.83	2.6
Phosphorus Bray II (ppm)	1.33	1.48	1.02
Aluminium (Meq/100g)	3.6	1.75	2.8
PH	4.1	6.5	4.2
ECEC(Meq/100g)	4.9	4.8	4.0

Source: Rivas 2000

In table 15. the behaviour of the chemical variables for different types of soil in the region, can be observed. It shows that the percentage of C is much higher in the forest, of 10 %, and the coffee with shade of 8.83 %, while this variable has been reduced to 2.6 % for those soils where monocultures of yuca are sown. The first two kinds of soil use provide a great amount of organic matter, while the second one leaves the soil more exposed to the impact of hydric erosion. The contents of P and CECe have better values for the forest (P:1.33 ppm.; CECe: 4.9meq/100g) and the coffee with shade (P: 1.48% ; CECe 4.8 meq/100g), in comparison to the soils where Cassava is sown (P: 1.02 ppm.; CECe 4.0 meq/100g). According to a study by Ashby in 1990, parcels with Cassava tend to show of M.O; K exchangeable, lower pH and % of higher Aluminium saturation.

5.5 Soil erosion in the zone

According to Ruppenthal (1996), in a previous study on soil erosion in the zone (Santader de Quilichao), in soils classified as Oxic dystropept, with pendants of more than 13 %, the factor K of the USLE (Universal Soil Loss Equation) was demonstrated as follows:

In parcels with cultures of 1990-1991, the erodibility of k was of 0.015, while those without vegetal cover had a factor K of0.018. This value K had been lower in the previous years, which means that the soil had been more resistant against erosion (See Table 16). The soil progressively lost ist stability of structure and the resistance against erosion, due to the type of agricultural handling that had been taken place.

Table 16: Loss of soil and factor K of USLE in Santander de Quilichao, Colombia

Observation year	K	Loss soil (t /Ha)
1986-87	0.0014	15.0
1987-88	0.0040	49.2
1988-89	0.30	196.5
1989-90	--------	165.0
1990-91	0.0150	143.7
1991-92	0.0180	222.6

Source: Ruppenthal 1996

According to Leihner *et al.,* 1997, when comparing the influence of erodibility with the erosive power of the rain (factor R) and the agronomic handling (factor C), it was found out that the first one is relatively low and that the parameter of major impact was the factor C (agronomic handling). The relative loss of soil is influenced by the agronomic handling (basically by the cover), which had the strongest variation (between 0.01 and 1.44), leading to a factor of variation of 144. Table 17.

Table 17: Minimal Value, maximal value of the soil's erodability (K), of the rain's erosive power (R) and of the factor of agronomic handling (C) during the crop year 1990-1991, Santander Quilichao Colombia.

Value	Factors		
	K	R	C
Minimal Value	0.015	100	0.01
Maximal Value	0.018	1400	1.44
Variation Factor	1.2	14	144

Source: Leihner *et al.* (1996)

5.6 Characteristics main Chemical soil Indicators

In the following passages, the actual behaviour of the chemical soil parameters and the evolution during the last thirty years are presented. The first one was done judging by 250 soil samples, taken on the farms of the high, medium and low watershed's zones.

With the objective of getting a more detailed and precise information, the nutrient's behaviour is presented by zones, as we have three different agroecological zones, apart from having different soil use.

5.6.1 Organic Matter

Soil organic matter (SOM) is a generic term for all organic compounds in the soil that are not living roots or animals. SOM has been characterized in various ways: by origin, transformation stage, function, solubility, chemical constituents, elemental carbon: nitrogen (C/N) ratio, exchange capacity, functional activity level, or dynamics and stability (Parton *et al.,* 1987; Anderson and Ingram, 1993; Feller and Beare, 1997; Paustian *et al*., 1997; Smith *et al*., 1997a; Baldock and Nelson, 1999). In well-drained, non-acid soils which occupy most agricultural lands there is a balanced and dynamic composition of chemical compounds with a high degree of humification, resulting in medium to low C/N ratios (10–12). (Watson *et al.,* 2000).

Organic matter decomposition is influenced by numerous physical, chemical, and biological factors that control the activity of microorganisms and soil fauna (Swift *et al.,* 1999). These factors include the abiotic environment (temperature, water, aeration, pH-value, mineral nutrients), plant residue quality (i.e., C:N ratio and lignin content), soil texture and mineralogy, and soil disturbance (tillage, traffic, logging, grazing, etc.). The root system, depth distribution, and chemical characteristics of the root biomass also play significant roles in SOM dynamics (Gale and Cambardella, 1999). Practices that reduce the decomposition rate by altering these physical, chemical, or biological controls also lead to carbon storage.

The carbon (C) forms all the organic substances for that reason often is enunciated organic carbon instead of organic matter. To transform values of organic carbon into Organic matter is used the factor of multiplication 1.724.

Carbon

Nearly 80% of the soil samples consist of medium and low carbon contents. In Fig 8 it is shown that there are significant statistic differences between Carbon of the high (6.57%), medium (5.57%) and low (4.3%) zones of the watershed.

In the Andine systems it is observed that the SOM content increases together with the height. This phenomenon is the result of two factors: First, the increase of precipitation with the height, which generates a major production of vegetal matter and speeds up the soil's development (Thouret and Faiver, 1995). Second, the reduced mineralization which is due to lower temperatures at height (Jenny et al. 1948). This is proved for Fig 8.

From Fig. 8, it can also be concluded that there's a major content of C in the high and medium zones, as there is a major presence of the agroforestry coffee system, which protects and improves the conditions for organic matter, whereas in the low zone there's a major exploitation of the monoculture of Cassava.

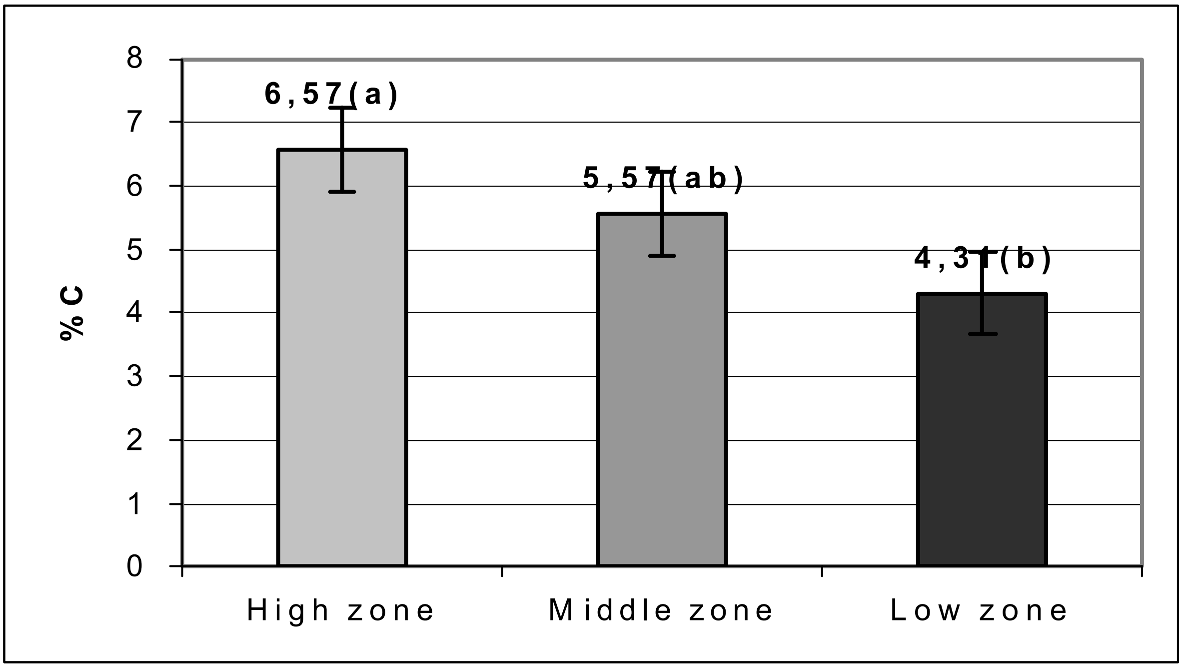


Figure: 8. Comparison of %C in the different zones in Cauyal (1970-2001)

After some time, it can be observed that Carbon tends to increase slightly from 4.5% in 1972 to 6.35% in 2001. The correlation coefficient (R^2=0.50) (See Fig.9).

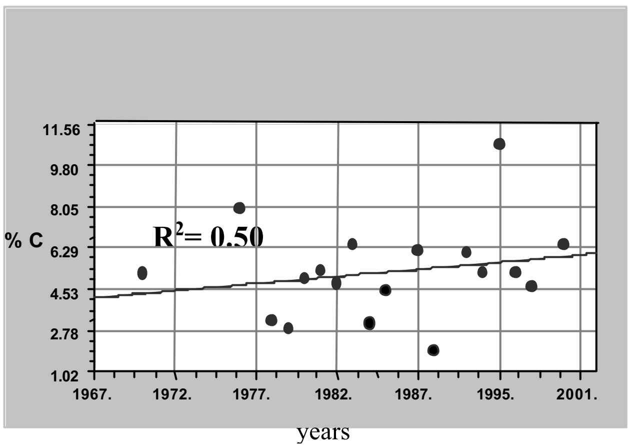


Figure 9: Tendency of Carbon (C) in thirty year (1970-2001) in Colombia
(Data Bank Secretaría Agricultura Cauca-CIAT)

In Fig. 10 the behaviour of C through time can be observed, and for different periods, it shows how the percentage of Carbon has improved. When comparing for example the periods 1980-85 and 1992-2000, a tendency to increase of the Carbon percentage, which is located in X, is observed.

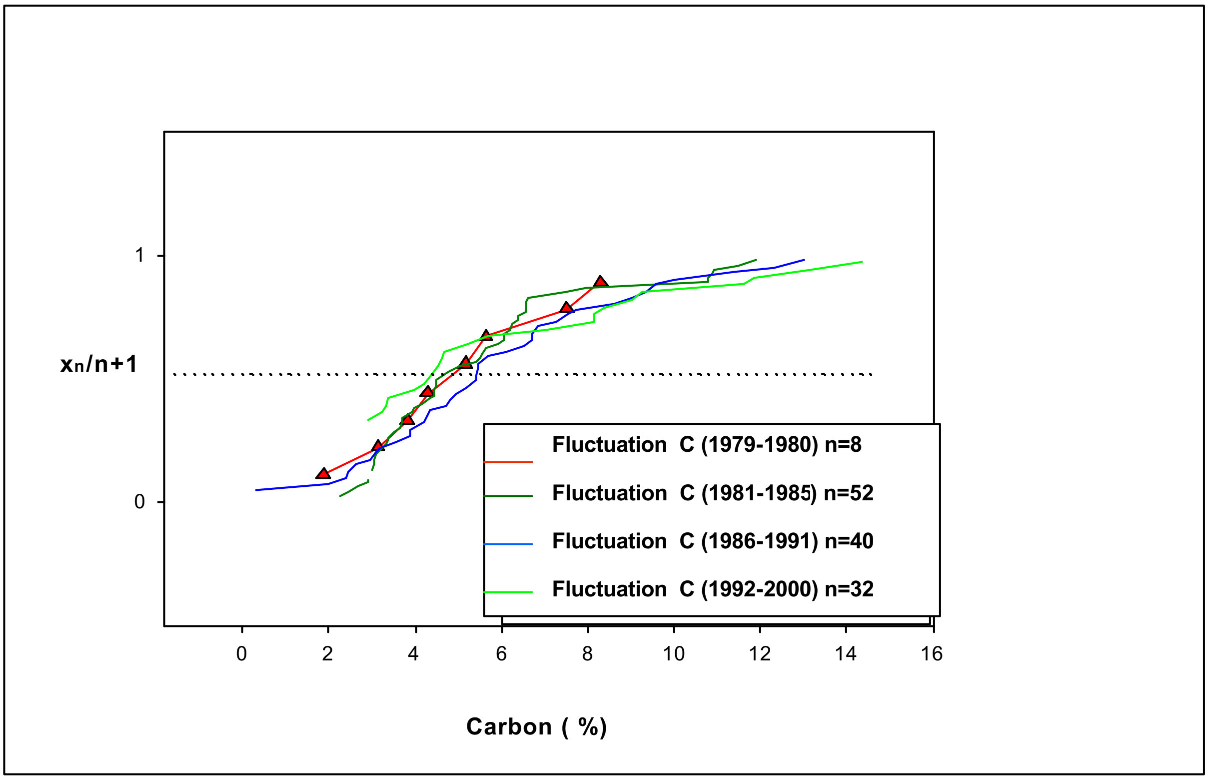


Figure 10: Variation of the carbon total (Ct) in different periods, 1970-2002, Cabuyal Colombia (Data Bank Secretaría Agricultura Cauca-CIAT)

5.6.2 Phosphorus

In acid soils, an absorption of P in large quantities by Fe and Al in tropical soils, like Oxisoles, Ultisoles and Alfisoles (Benzing, 2002) takes place. The absorption of P is related to the content of the organic matter, and the pH-value (Guerrero, 1972).

The values of Phosphorus are low, although significant statistic differences have been observed in the high, medium and low regions. Their valours were 6.62 ppm., 3.89 ppm., and 2.13 ppm respectively (See Fig.11) In time, phosphorus increases from 0.70 ppm. to 6.00 ppm. (See Fig.12), and the agriculturists themselves have informed that the practice of liming has been used for more than 30 years while introducing the coffee to the zone. The liming is a simple and economic option to increase the disposal of Phosphorus by improvement of the pH-value. (Fassbender and Molina, 1969).

That's why in many soils the reserves of organic P have a major disposal for the crops than the non-organic forms. Thus P gets lost basically through erosion rather than by other causes. But when great amounts of P are induced to the soil, the access for the plants can be difficult.

The majority of andine soils present a deficiency of disposable P (Benzing, 2001). The main way P gets lost is, as mentioned before, through erosion. (Carpenter *et.al.,* 1998 cited by Benzing, 2001).

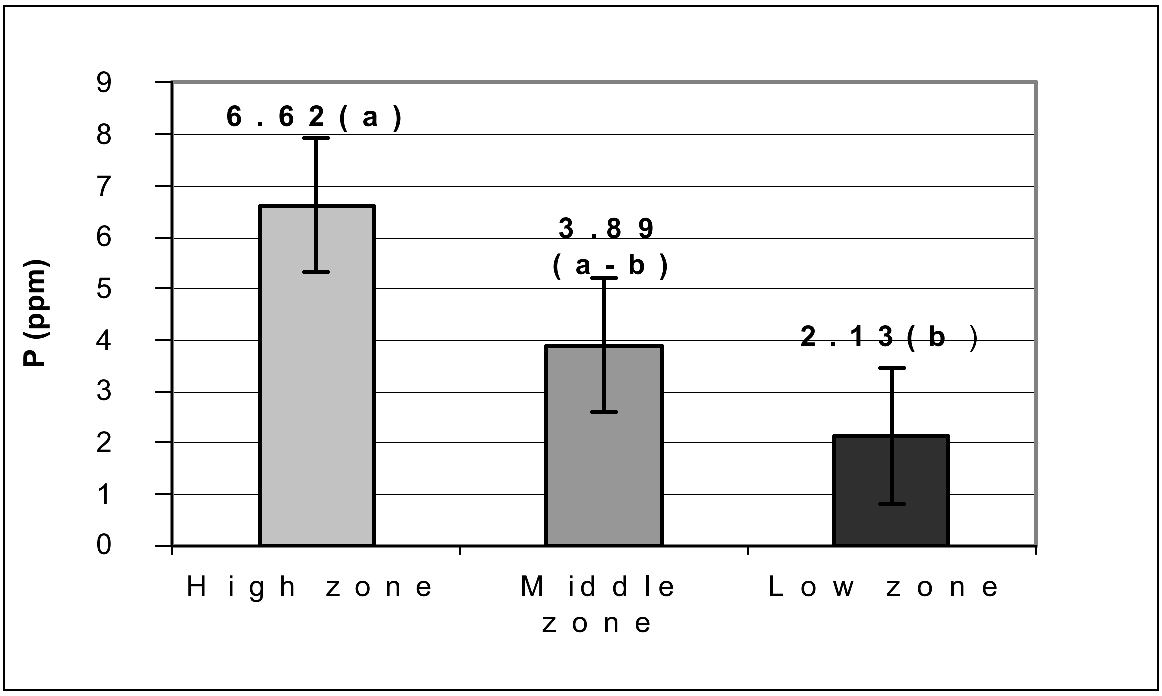


Figure 11: Comparison of P (ppm.) the different zones in Cauyal (1970-2001)

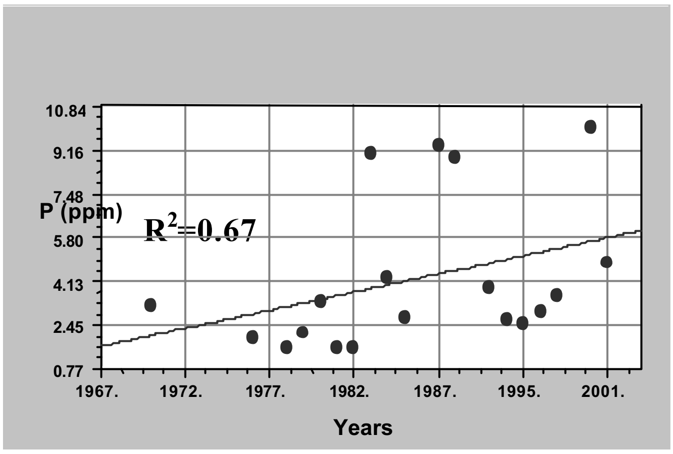


Figure 12*:* Tendency of Phosphorus (P) in thirty years in Cabuyal Colombia, (1970-2001) (Data Bank Secretaría Agricultura Cauca-CIAT)

5.6.3 pH-value

The majority of these soils present a pH-value below 5.5 For the high, medium and low zones there is estimated a pH of 4.91, 4.86 and 5.34 respectively. (Fig 13) This means that trivalent Aluminium is absorpted by the cation change, forms hydroxialuminium when hydrolizing, and liberates ions of hydronium which are the cause of the pH-value between 4.0 and 5.5.

Of course, there exist few ions of Calcium (Ca), Magnesium (Mg), Potassium (K) and Sodium (Na) in the complex of change.

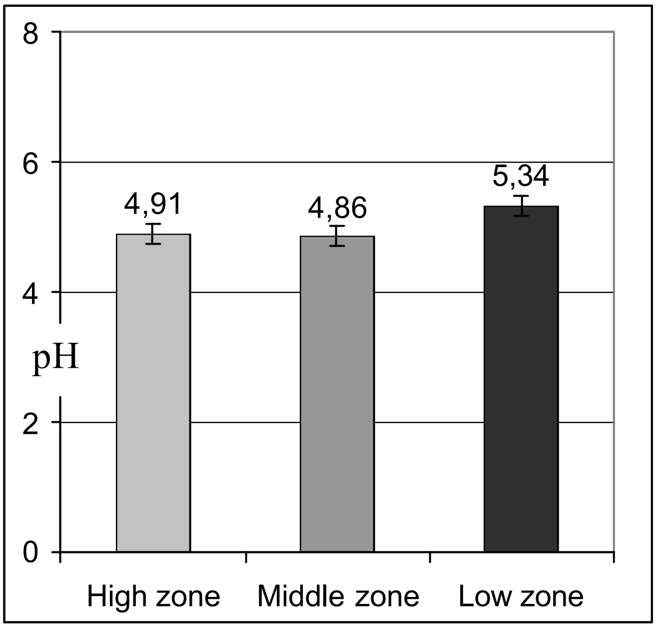


Figure 13: pH Comparison for the different zones from basin of the Cabuyal river

5.6.4 Cation exchange capacity (CECe)

This chemical indicator was analized after having determined the four principal cations that compose it. Calcium (Ca); Magnesium (Mg), Potassium (K); Sodium (Na), (Fe), Manganessium (Mn) and Aluminium (Al) and the CECe is the sum of the previous bases.

In Fig 14 and 15 the improvement of the CECe of 1972 in 2.66 meq/100g to 4.4 meq/100g in the 2001 can be seen. This improvement is given due to the use of organic fertilizers like poultry dung and compost, and due to the use of the agroforestry system of coffee cultures. This system, apart from providing a high content of organic matter, protects the soil of the rain's and sun's impacts. It has to be emphasized that of all organic fertilizers, the poultry dung has the greatest content of N, P K, Mg y Ca (King, 1994).

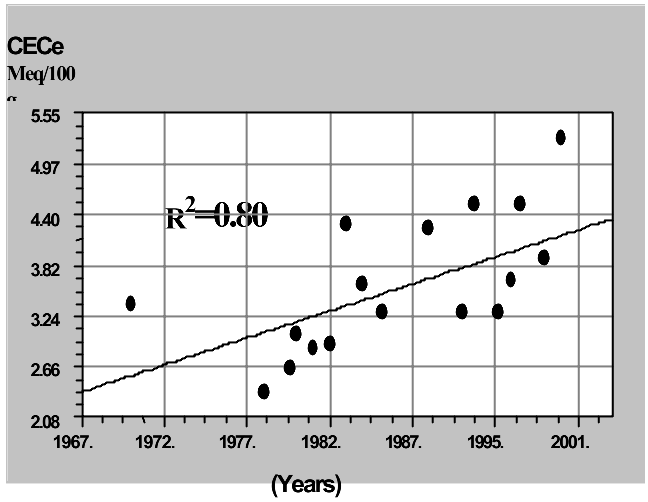


Figure 14: Tendency and improvement of the CECe in thirty years in Cabuyal Colombia (1970-2001) (Data Bank Secretaría Agricultura Cauca-CIAT)

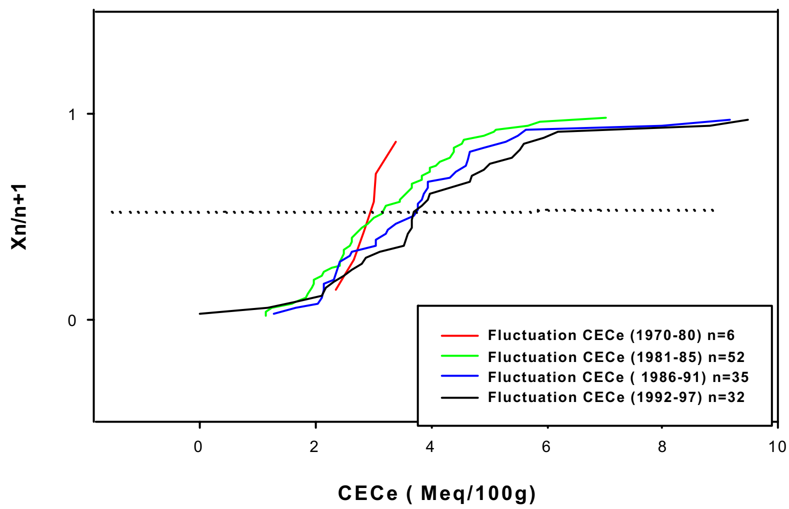


Figure 15: Fluctuation of CECe (meq/100g) in differents periods in Cabuyal Colombia (Data Bank Secretaría Agricultura Cauca-CIAT)

Basic Cations

These minerals are found as primary or secondary minerals.

In Fig. 16 it can be observed that the mostly presented cation is Ca, a fact that coincides with prevously realized works by Blasco (1984) and Thouret e Faivare (1995).

The value of cations in the different zones from cabuyal is different depending on the height, because in Andean ecosystems it is observed that to zone height the cation concentration is greater. (See Fig 16). In the zone it lowers the values of Ca, Mg and K is: 0.22meq/100g, 0.34 meq/100g and 0.97 meq/100g respectively whereas in the high zone these 0.36 meq/100g; 0.47 meq/100g and 1.44 meq /100g.

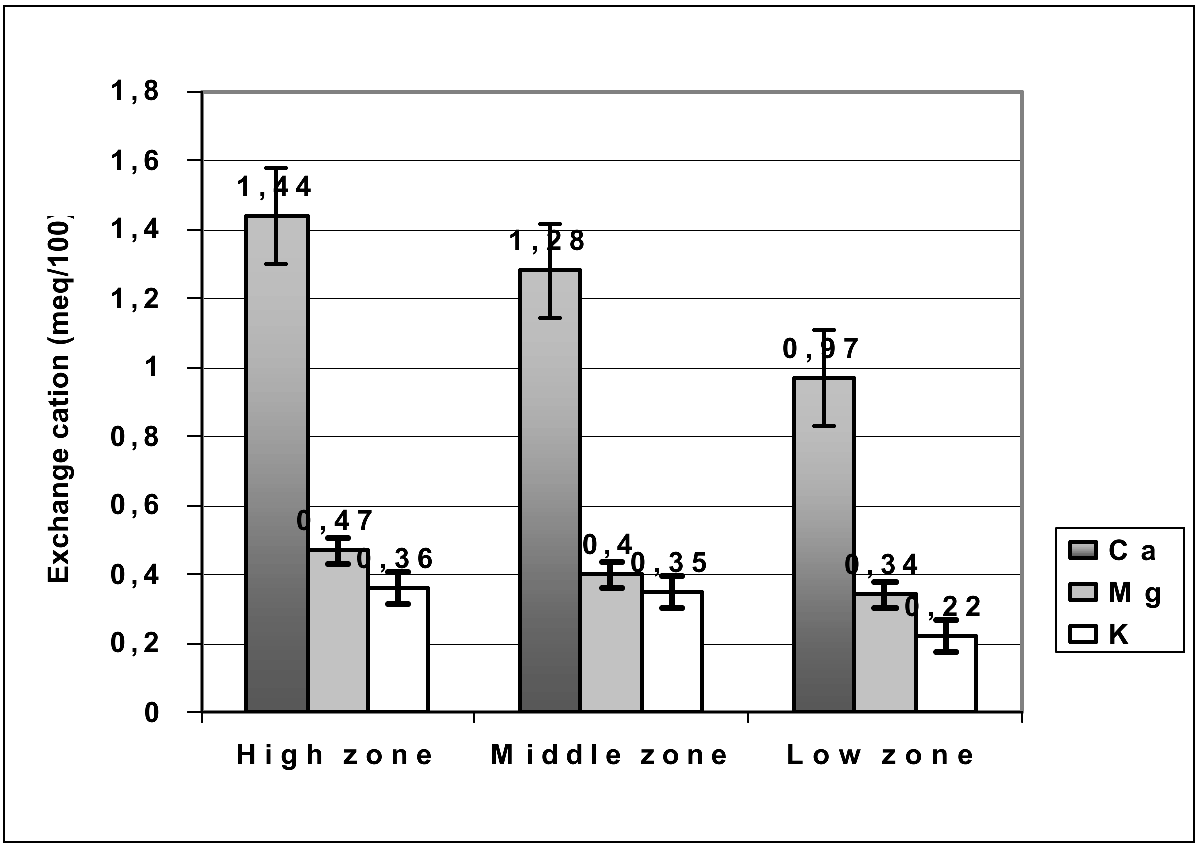


Figure 16: Exchange cations in the differents zone in Cabuyal

Another reason for the differences of values of bases (Ca, Mg, K) is the kind of soil use in the different zones of the watershed. Thus for example, in the medium and high zones, there's a greater use of organic fertilizers, as well as the application of an agroforestal system of coffee cultures.

5.6.4.1 Calcium

It can be clearly seen how the content of Ca has been increasing during different periods. From 1979 to 1980 it had an average of nearly 1.90 meq/100g, but between 1992 and 2000 it had increased to nearly 4 meq/100g. This increase of Ca could be explained with the practice of "liming", which has been used very much in the Cabuyal zone for more than thirty years to correct the pH-value (See Fig.17). In curved soils in Peru and Ecuador, Blasco *et al.,* 1984 observed a very clear positive realation between pH y the saturation of the base, as the concentration of Ca^{2+} increased with the increase of the pH (Del Posso and Luzuriaga, 1984).

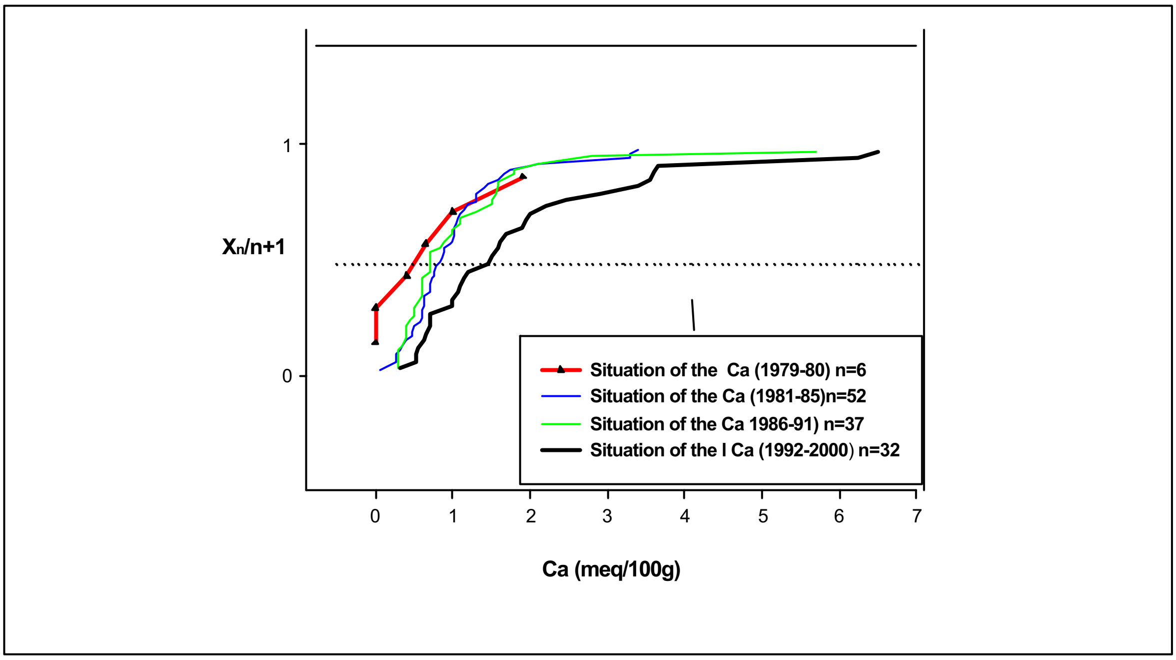


Figure 17: Fluctuation of the Ca in different periods in Cabuyal 1970-2000 Cabuyal, Cauca Colombia (Data Bank Secretaría Agricultura Cauca-CIAT)

5.6.4.2 Magnesium

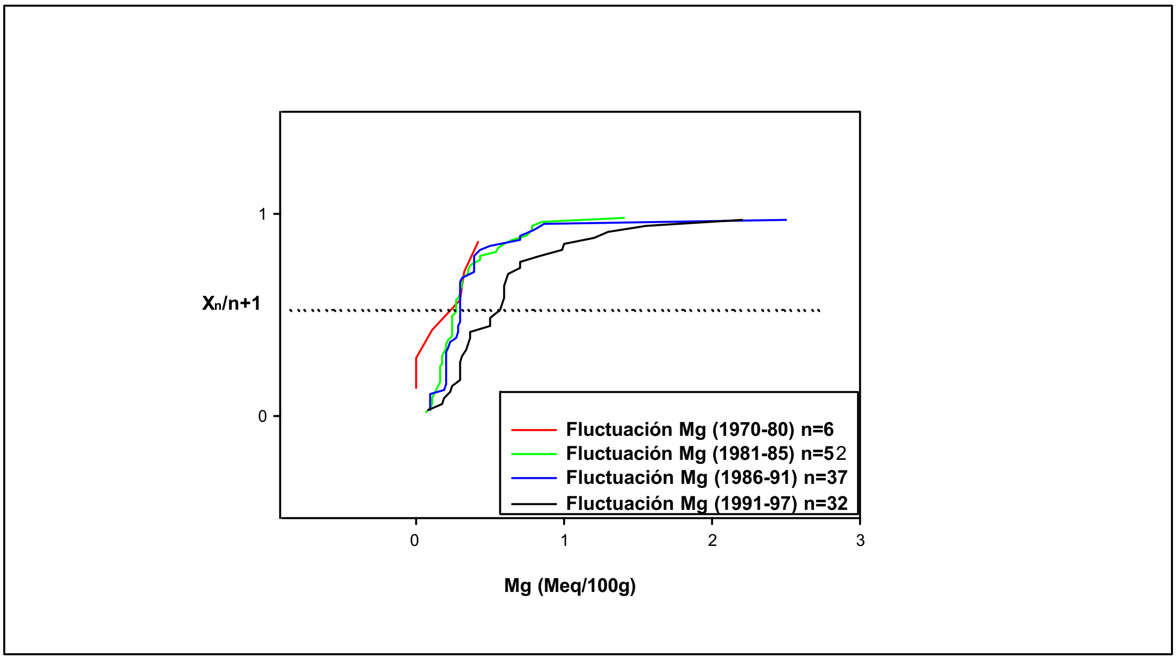


Figure 18: Fluctuation of the Mg in diferents periods in Cabuyal 1970-2000 Cabuyal, Colombia (Data Bank Secretaría Agricultura Cauca-CIAT)

The Magnesium of the watershed has been improving: between 1970 and 1980 its value was 0.4 Meq/100g; between 1991 and 1997 it was 0.9 meq/100g. This can be observed in Fig. 18. The improvement of Mg can't be adjudged to the correction of pH, as according to Del Posso and Luzuriaga (1984) there's no direct relation between them. Maybe this improvement is due to the application of organic fertilizers, such as poultry dung and compost.

There is no significant statistic difference for the content of Mg in the different agroecological regions. For the high zone there is an average value of 0.47 meq/100g, in the medium zone 0.4 meq/100g and in the low zone of 0.35 meq/100g. this can be seen in Fig. 19.

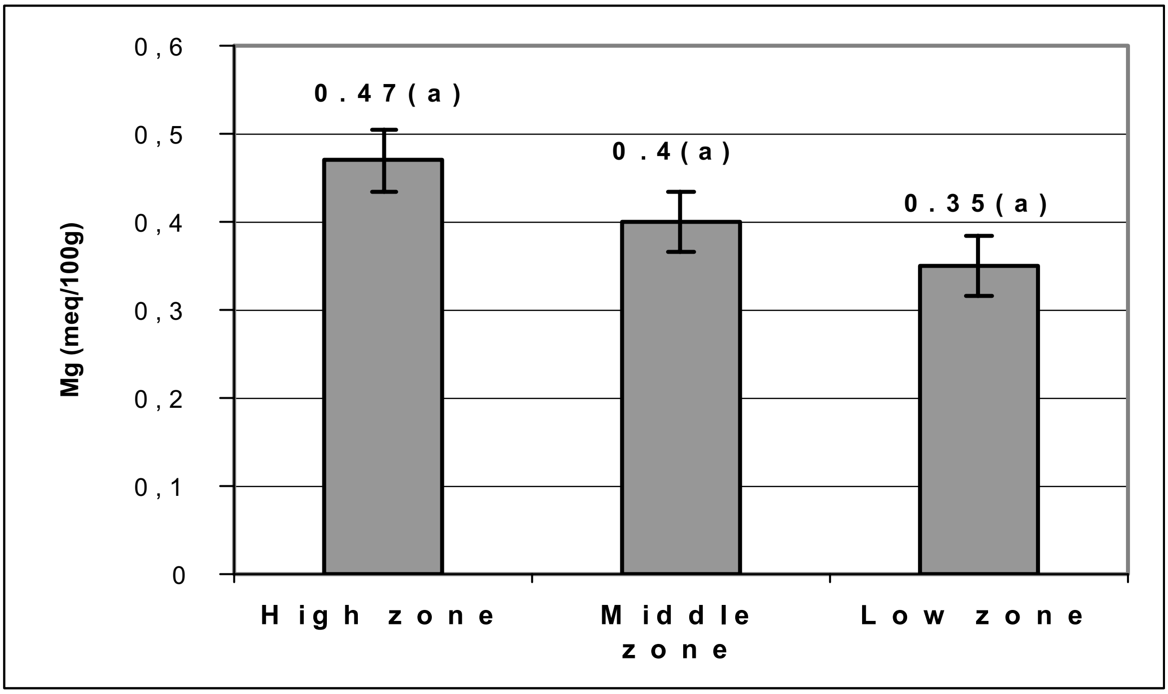


Figure 19: Comparison Mg for the different zones from basin of the Cabuyal

5.6.4.3 Potassium K

In soils with more exchangeable K, also the concentration of Ca and Mg generally increases within the exchanging elements. Rarely in the andine soils K decreases. Furthermore, there is a positive relation between the pH- value and the saturation of the bases, and of course of K.(Posso and Luzuriga 1984).

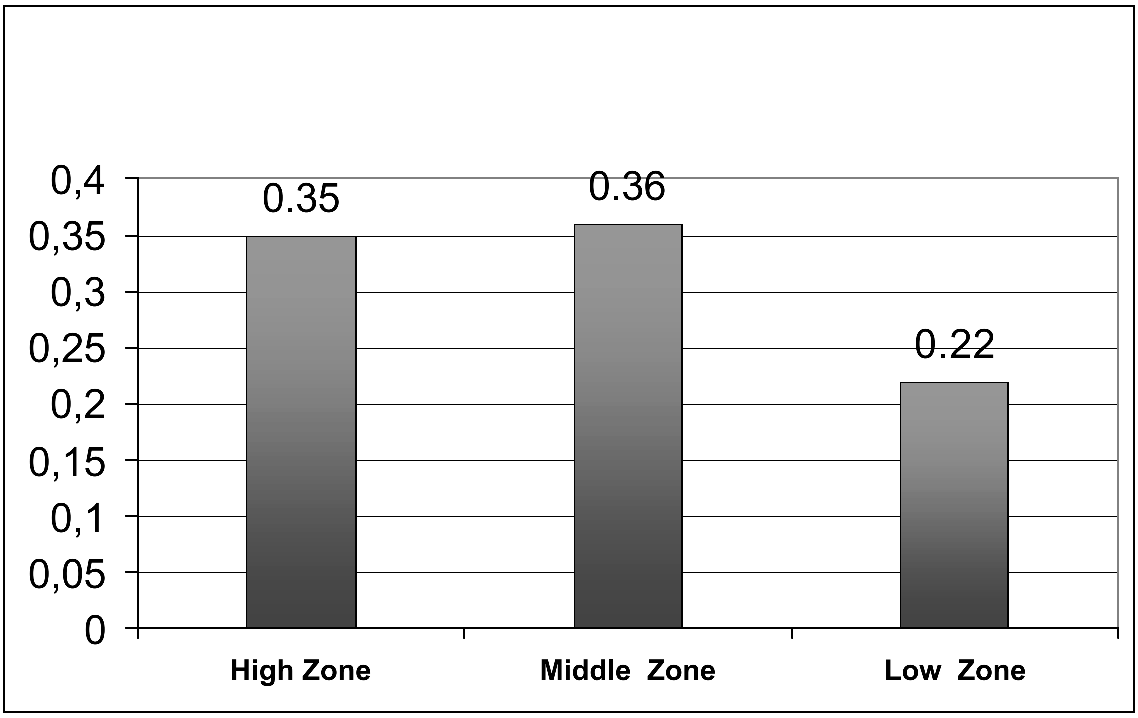


Figure 20: Comparison K for the different zones from basin of the Cabuyal

The high and medium zones present a similar behaviour of K, with a value of 0.3 meq/100g and 0.35 meq/100g, but there are significative differences in the low zone, with a value much below 0.22meq/100g. (Fig.20).

5.6.4.4 Aluminium

This is the soil's most important chemical characteristic. It influences nearly every aspect in a certain way (Bloom, 2000). One of the worst effects of acidity is the solubility of Al which constitutes a toxic element for the plants. Volcanic, non-alofanic soils can present problems of toxicity of Al (Shoji *et al*, 1993), affecting the activity of microorganisms, as well as the availability of nutrients, and due to this, the growth of the cultures.

A pH-value of 6.0 and for andosols between 5.5 and 5.8 would be sufficient. In the Cabuyal zone it can be observed how the improvement of the pH-value directly influences the reduction of the Aluminium's saturation percentage during the last thirty years.
After some time, it can be observed that Al tends to decrease from 73% in 1972 to 28.% in 2000. Nonetheless the correlation coefficient (R^2=0.70) is high. (Fig. 21).

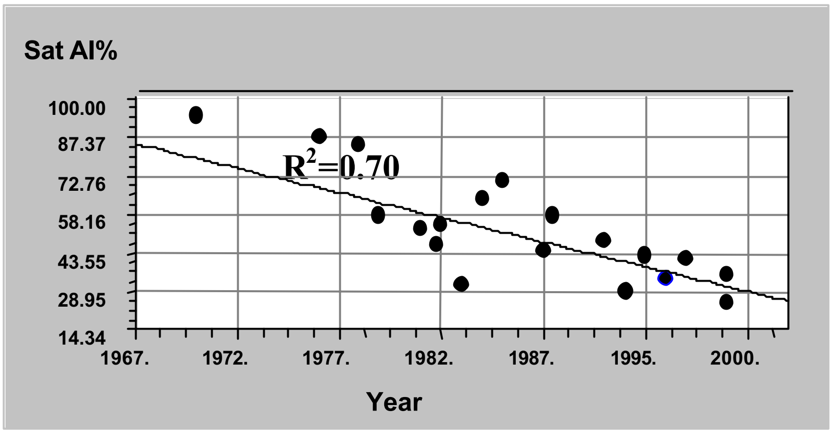


Figure 21: Tendency of the Saturation Al (%) in Cabuyal Colombia 1976-2000) (Data Bank Secretaría Agricultura Cauca-CIAT)

Fig. 22 proves that the percentage of Al (%) during the period 1970-80 is higher than 70%, and during the period 1986-91 it is reduced to values near 25%.

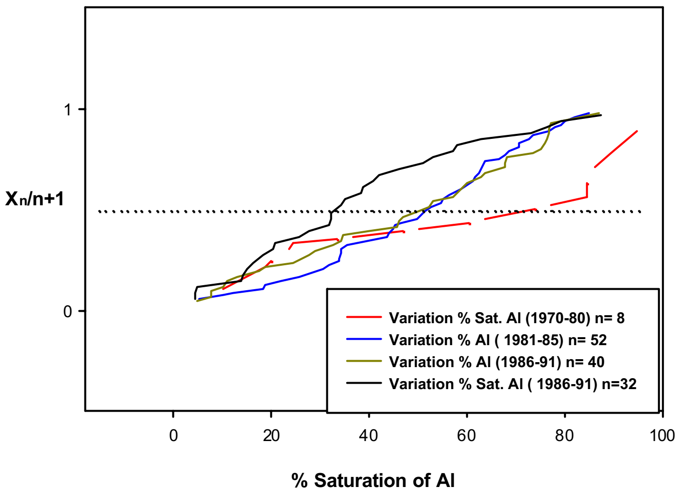


Figure 22: Variation of the % saturation Aluminiun in differents periods in Cabuyal, Colombia (Data Bank Secretaría Agricultura Cauca-CIAT)

5.6.5 Correlation of chemical parameters

The correlation test Sperman of the analyses shows a high correlation among the soil analyses. Thus, for example, the strong influence of the pH and the Aluminium with a high correlation coefficient (0.74) can be appreciated, as well as a high correlation of the pH and the CECe with a value of (0.88). In addition, a high correlation between the Aluniniumand the CECe is observed. Their correlation value is of (0.94) (Table 18). This allows to deduce how the improvement of pH within the watershed has contributed thus to the improvement of CECe and of the Aluminium. Nonetheless, the solubility of Al and the severity of its toxic effects for the plants is affected by various factors of the soil, including pH, predominant clay, concentration of other cations and content of organic matter (McLean 1976). See Appendix No. 1 and Table 18. The disposal of micronutrients depends on the high grade of pH of the soil (Morvedt, 2000).

Table 18: Correlation between chemicals parameters of soil

Correlation Matrix					
	pH	Carbon	Aluminium	Phosphorus	ECEC
PH	1.000	-0.3031	**0.7405**	0.2985	**0.8835**
Carbon	0.3031	1.0000	0.1121	0.0812	0.0397
Aluminium	0.5405	0.1121	1.0000	0.2331	**0.9405**
Phosphorus	0.2985	0.0812	0.2331	1.0000	0.4888
ECEC	0.3835	0.5405	0.4888	1.0000	0.567

5.7 Local evaluation of the quality soil

Local evaluation of the quality soil to identify the soils that are important to peasants, determine each soil. Benefits for development include production of soil´s relative productivity, and locate typical examples of ecah soil. Benefits for development include better understanding of the rationale behind management practicies and the type of soil information that would help the peasants.

5.7.1 Soil classification according to specific qualities (See Table 19 - 20)

Accordin to Ceron 2001 These soils have a specific attribute and they name them by a qualifying Adjective: When trying to establish the correspondence between the academic knowledge and the local classification, referring to specific qualities, the following is considered: that the definition and oppositions, expressed in the spoken discourse by the peasants, the denominations of "soils, have their origin in the relief, the first horizons of the soils profile, and their physical characteristics, like color, consistency, structure, humidity and the draining. Consequently, differences in consistency, speed infiltration, texture, between "loose" and "ceruda" soils in structure, especially in the size of aggregates, with reference to the "polvosa" and the "granosa" soils, are considered. Furthermore the amount of organic matter and color between the "black soil", the "scrambled soil" and the "red soil" varies, and there is a different grade of humidity, according to the type of use of the ground. In addition, a clay and humidity gradient throughout the slope can appear. Asocianes can be established in the table 19.

Cultural categories specified by the peasants in their speech were those of "good soil", "tired soil", "brave soil" and "bad soil". The cultural categories, although being part of the collective memory, are expressed individually and put down to particular experiences, unlike the referring ones used for specific qualities in which it is possible to find greater homogeneity and agreement in the denominations and the definitions used by the peasants.(Ceron, 2001)

The categories are not fixed, static, through time and there is no unique definition for each cultural category used by all the peasants because they have a dynamic use. Therefore the peasants give them form, according to their context, and combining different references, such as the location, the experience with the use and handling of soils, the recognition of some plants and macroinvertebrates of soil, the referring valuation and transformations and specific quality of the soils, plus the thickness of the organic horizon.

5.7.1.1 Black Soil

Located in the forests or the coffee plantations with shady and it is the superficial layer of the land and it is characterized being of black color brown.

These soils are used basically to cultivate maize, coffee and red beans. No chemical fertilizers are used. About once a year poultry dung is applicated. Weeds are placed in the mulches to let them disintegrate and serve as fertilizer.
Due to the soil's ability of retaining much humidity, and to their high content of organic matter, the rain's water supply is sufficient.

5.7.1.2 Red Soil

The red soils are characterized by their ability of retaining much humidity, and to adhere easily to hands and tools. This means that farmers have a major physical effort. During rain periods these soils are very muddy.

5.7.1.3 Sticky soil (Suelo cerudo)

The ceruda soil is also called "sticky". It is recognized because it retains more humidity, the herbs grow faster than in loose soil, and it adheres easily to the hand and tools.
Thus for example it is affirmed by the peasant Gerardo Cifuentes:

> *The "ceruda" soil when it rains much is very hard and if one does not harvest fast, the yucca for example can be rotted. When this drought is very hard and it gets tired, one more working stops it. This is when it becomes like a mass and can be compressed to a ball. It serves to make bricks*

Cassava, red beans and tomatoes are sown here.

5.7.1.4 Loose soil (Suelo suelto)

It is a loose soil that crumbles when it is taken in the hand or with the tool. The water infiltrates easily, the earth dries faster and is easier to handle.

> *The loose soil is more sandy; it doesn't stick when one works with the rake. It is easy to handle, but the problem is that it dries much faster after being watered. (Interview No. 5 2001 Alberto Rivera)*

Cassava and red beans are sown in this soil.

5.7.1.5 Grains soil - Polvosa Soil

The well-known grains soil this located in the cultures of coffee with shade.
The Peasants differentiate "the granosa land " from "the polvosa land" because in dry season, when they take the soil in the hand it drops. If it is crumby it falls vertically because it is heavy, whereas if it is polvosa dragged by the wind due to its oblique form.

5.7. 1.6 Humid Soil

This type of soil is found in the forests and coffee plantations, as well as in the landscape around the low parts of the slope and around the water sources. Earthworms are associated with the humid soil. The plants of ortiga *Urera bacifera* and trees like the nacedero *Trichantera gigantea*, cachimbo *Erythrina sp.* and guamo *Inga sp.* and the herbaceous ardent flower *Impatien balsam* apple are also associated with the humid soil.

5.5.1.7 Hill soil-Plane

In agreement with the topography the farmers denominate "planada" to flat lands without slope and in the zone of slope are called Hill soil.

The hill soil is considered more drought and depending on its use it is red or yellow for cultures of short cycle (maniok, fríjol, maize) although for coffee it is humid, crumby and black.

Table 19: Relation between the local soil classification and the academic knowledge

Quality	Local name	Local definition	Scientific de finition
Color and horizon in the profile.	Black	-It remains humid, it is loose, soft, easy to weed, needs less fertilizer.	-Superficial horizon with greater proportion of organic matter
	Coffee, Red	-In the hill, it has less vegetal layer, the water takes easier that the less granosa black to it. -Under the black soil or in bare hills and it does not have vegetal layer.	-Transition between the organic and mineral horizon -Mineral horizon with ferric iron predominance of low hidratation.
	Yellow	-In the hill, dry yellow and wet coffee.	-Mineral horizon with ferrous iron hydrated or aluminum oxides.
Consistency, Drainage and texture	Sticky or Ceruda	-In summer it is hard like a stone, very tightened and dry. In winter it is a mud. She is sticky. Conserve much water.	-Dry. It has consistency lasts and humid greater degree of adhesion and plasticity. High proportion of clay.
	Loose or sandy.	-In summer it is dried very fast, the water to conserve with facility, it is loose, easy to handle, crumbles.	-Greater flow of water through the profile, minor coherence adhesion and plasticity, discharge proportion of sand or organic matter.
	Soft or loose	-Loose, easy to handle and to weed.	-Less consistency by greater proportion of sand or the content of organic matter.
Structure	Granosa	-Form grain	-Greater size of aggregates.
	Polvosa	-Dust, does not have grains.	-So large aggregate minor
Humidity	Humid	-Conserve more humidity.	-Greater humidity by location or greater content of clay or organic matter.
	Dry	-It does not keep humidity.	-Smaller humidity by location in slope, little cover or greater proportion of sand.
Relief	Hill	-In hill, minor castrates organic, less humidity.	-Slope, topography very broken with high slope degree.
	Plane	-Flat. But layer organic matter More humidity, more Earthworms.	-Flat topography or slightly inclined.

Source: Ceron 2001)

Table 20: Relation between the local soil classification and management

Local name	Cultures	Dung	Irrigation	Weed control	Soil protection
Black	Mays, Fruits, Bean, Coffee.	Liming One time annual fertilization with poultry dung. Mulch of Weed.	Rains. Furrow irrigation for Bean.	Weeding machine Manual.	Contour ploughin., Mulching.
Coffee, Red	Coffee and Fruits. Manioc	Liming One time annual fertilization with poultry dung. Mulch of Weed.	Rains	Weeding machine Manual.	Mulching Contour ploughin
Yellow	Coffee and fruits	Liming. Two or three time annual fertilization with poultry dung. . Mulch of Weed.	Rains	Weeding machine or Manual.	
Sticky or Ceruda	Manioc, bean, tomato, pastures.	Liming, fertilization with poultry dung.	Rains Furrow irrigation for Bean and tomato.	Weeding machine or Manual	
Loose or sandy	Pastures, Cane	Pastures, Cane	Rains	Weeding machine or Manual	
Soft or loose	Tomato, Bean, Manioc	fertilization with poultry dung.	Rains Furrow irrigation for Bean.	Weeding machine or Manual	
Granosa	Coffee, bean, Manioc	One times annual fertilization with poultry or compost.	Rains Furrow irrigation for Bean.	Weeding machine or Manual	
Polvosa	Pastures	Cow dung Liming.	Rains	Weeding machine or Manual	
Humid	Forest, Coffee, Fruits	One times annual fertilization with poultry or compost.	Rains	Weeding machine or Manual	
Dry	Pastures	Cow dung	Rains	Weeding machine or Manual	
Hill	Coffee, Bean, Fruits, Forest, Cane	Two times annual fertilization with poultry dung.	Rains Furrow irrigation for Bean.	Weeding machine or Manual	
Plane	Tomato, Beans, Manioc	One time annual fertilization with poultry or compost.	Rains Furrow irrigation for Bean.	Weeding machine or Manual	

Source: Rivas 2003

5.7.2 Cultural categories

This group of soils, denominated cultural categories, is not only characterized by the soil's properties, but by the form and sense the agriculturists give them through the following aspects: combinations and integration of various specific qualities of the soil, location, the peasant´s daily experience, observation of the vegetation, and the soil's transformations.(Ceron 2001)

5.7.2.1 Good Soil

Good soil is located on the level of fertile river valley landscapes, or on flat and low hill zones:

> *The good soil is black and found in fertile valleys or where there are many nacederos. The good soil is loose, dark, humid and has many earthworms. In addition, many plants like f.e. the papunga, are grown there. The coffee plantations have very good soils now, because their grounds previously have been yellow and bare (Interview with Mr. Gerardo Cifuentes).*

It can be observed that soils where you have coffee cultures with shady, are good soils. These soils, where coffee with shady is grown, get a major supply of organic matter, contributed by the shady. This and also the cultural practices, like f.e. the liming, allow to conserve humidity and to avoid erosion. According to the words of soil peasants of the coffee plantations, their soil has a „heavy organic layer", is black and „crumby".

> *As far as the handling of the soil is concerned, it is a good one when not many fertilizers are used and when it is „soft", as the peasants call it. This means that it facilitates the working preparation . Thus f.e. the soils of coffee with shady present these characteristics, because not many fertilizers are used there, and it is loose, so that weeds can work). In general terms the soils of dark, black or brown color are considered good because they are loose and have good organic matter, thus f.e. affirms Mr. Elías Claros.*

Concerning the relation between the soil and the vegetation, peasants observe the growth, the vigor, the color and the production of the cultures, as well as of the wild plants:

> *In the depression, the humidity is kept and the plants seem to have a more intense green color. Because water is transformed there, the land is more protected and has been fertilized more. The depression is better because there the plants grow better and vigorously. It is observed thate the small Piper aduncum is not so abundant . The one of the depression is higher and has the same sowing time)(Interview with Ana Mendez).*

In cultivated lands the peasants have observed the relation of good grounds and the major presence and greater amount of weeds, than the one observed in table 19.
The good soil is related basically to forests and to coffee plantations with shady, places where there is a continous contribution of organic matter, which is an important component of the dynamic of soils, since it regulates the chemical processes that happen, improves the physical properties of the ground and is constituted in the nucleus of most of the biological activities of the soil. The organic matter has capacity of retaining humidity, of increasing the porosity, and therefore of improving the ventilation and the permeability. The run-off, the erosion, and the effect of the raindrops impact is reduced, the cation exchange capacity increased, and the contribution of nutrients, that are released in their process of decomposition, is improved. (Burbano, 1989).

Considering the characteristics of the soils, the „good soil" is associated with a black colour, a loose consistency and humidity. The black colour is associated with a major content of organic matter. The organic matter can retain up to twenty times ist weight o f water to reduce the loss by evapotranspiration and in sandy soils it can improve the humidity retention significantly (Burbano, 1989).

The crumby soil. Thus for example Primavessi (1997) and other authors have demonstrated that The soil's structure is a product of the complex interaction between different factors of organic and inorganic origin. The content of organic matter is an important factor because it makes the interaction and the activity of the organisms possible. This leads to the generation of aggregant agents that play a role for the construction and the stability of the soil's biostructure, aggregate structure to the water. The biostructure is of great importance for the soil quality because it allows to maintain porous a continuous space, so that it allows a suitable movement of the water, a continous gas flow and a good penetration by the roots (Tisdall and Oades, 1982; Primavessi, 1982).

In agreement with the investigation of Feijoo *et al.* (1999) it was managed to demonstrate that the best quality of grounds is associated with a greater amount of invertebrates, pertaining to *coleopters, diplopodos* and *annelids*. The earthworms are found in greater amounts and in the low part of the slope. The authors mentioned before, confirm the relation between the humidity and the earthworms through the revision of specialized Literature. They show that there is a direct relation between the percentage of humidity and the earthworms. The fertilization, the rate of growth, the density and the percentage of cocoon presence, affected the reduction of humidity negatively.

5.7.2.2 Bad Soil

The peasants of this catchment area use the following terms as synonymous for bad soils: “tired soil”, “yellow soil”, “polvosa soil” and associate these with an land od little productivity, little organic matter and little retention of humidity. But in general the bad soil is associated with a yellow color and the lack of structure.

The bad quality of a soil is also determined by how much it is eroded, or if you only find *Pteridium aquilinum* there. The presence of this plant indicates a low level of pH- value.
For bad grounds the peasants José Adelmo Ul declares:

> *A soil is bad when it is very „polvosa“, because when it rains it becomes very sticky. In addition, it is necessary to pay.It enough, so that it produces. In a bad soil you find only few plants, and there´s not a good harvest, besides. (*Jose Adelmo Ul.)

Leihner *et al* (1999), from investigations on erosion in inceptisols, an Oxic Dystropet, in Santander and an Oxic Humitropet, in Mondomo, among other aspects concludes that: a) these soils offer a high inherent resistance to the erosion, b) After a prolonged rest, thanks to the grassland that settles down there, these soils are very stable, but they lose this quality from the third year of permanent culture, and c) when comparing the influence of the erodability with the one of the rain erosion and the agronomic handling, it was found out that first this influence was relatively low, and that the greater impact is given by the agronomic handling.
In Cabuyal the agricultural factor, concerning the erosion, is associated with the first years of establishment of the coffee culture, and with the transitory cultures, especially tomato and cassava. The cassava is a cause of the erosion since within some years, in a monoculture of cassava, it is possible to lose between 15 and 50 tons of soil/ha. There are between 10 and 15% in a slope. The sowing distance, the slow development, and the low initial cover are factors that affect the erosion related to this culture. (Mueller, *et al.,* 1994).

Castillo (1994) found in a study on erosion, with Oxic Distropet and an Oxic Humitropet, located in Santander and Mondomo, Cauca Colombia, that the proportion of aggregates smaller than 0.25 mm, was relatively greater when Cassava was handled in monoculture (10,000 plants/ ha). The study considers that apparently, in grounds of Mondomo, the handling and the degradation by erosion entails a state of practical pulverization, which requires a suitable handling and a regeneration of the structure. In addition, it says that the smaller stability of soils in Mondomo, compared with those of Santander, seems to proceed from minor contents of organic matter.

Recent observations propose that one of the reasons for the physical and chemical soil degradation in the Andine zone, is related to the soil's crusty surface. This proceeds from a fine soil layer hardened in the surface of the soil which develops during dry season.

The bad soil mainly describes a *raincoat surface* in humid circumstances. The raincoat surface develops when the dissolved aggregates infiltrate in pores of the soil, entailing to compact the soil's horizon and therefore reduce the capacity of infiltration. (Thierfelder *et al.*, 2000).

The peasants who own the yellow and polvosa soils consider these to have reached a state of very low quality. These soils which exhibit a yellow color on their surface horizon, have little humidity and lack of structure. The yellow color may have developed due to a greater proportion of iron in a ferrous and hydrated state during the mineral phase (Montenegro and Malagón, 1990). They also may proceed from greater proportions of Aluminium oxides (Trejos *et al.*, 1990).

From the peasant's opinion, an approach to the local classification and the cultural identification of transformations and movements in the soil can be obtained. This differentiation and identification is expressed by them through generating principles of classification that take place actually socially, that means, in the appreciation, the perception and the action with the soils, which can be organized referring to specific qualities and cultural categories. From the denominations, definitions and oppositions on the soil expressed in the speech, the conceptual correspondence with the academic knowledge and from demonstrating certain level of space heterogeneity in grounds of the zone of study there can be established.

5.7.2.3 Tierra cansada (Tired land)

The tired land is the one which progressively has been deteriorated, due to a continous work of the ground. The agriculturists perceive this with the culture of cassava in monoculture.
For example Milciades Branches declares

> *The tired soil is the one where yuca has been cultivated very much, and has been sown continously during three or four years without letting the soil rest. It is not good to plant a culture immediately after having harvested the previous one (Milciades Ramos)*

Some agriculturists show that after plowing, the land mustn't be left exposed to the sun, otherwise it dries and later on when it rains it is eroded. (hydric erosion).

Ohter agriculturists show that the cause of the deterioration of soils is the excessive use of chemical fertilizers:

> *„The chemical fertilizers have burned the soil of my parcel. It becomes dusty. The first sowing is very good, the second one also, and the third one leads to a bad harvest. This means that the land is tired. Whereas if there is poultry dung on the soil, there is a much better vegetation and agricultural production (Mr.Jorge Trujillo).*

They also observe that the horizon is diminished:

> *Therefore to plow deteriorates the soil, and you see that the superior layer (Horizon A) is reduced, the soil becomes dusty and the harvests are bad (Mr.Oliverio Troches)*

The peasants, when the soil is „tired", make rotations or let the soil rest, which consists in not working with it. Thus the natural fallow is allowed to develop, letting weeds grow, whose roots improve the soil. The following is expressed by Mr. Troches:

When the soil's tired it is left to rest and to let weeds grow. Then the roots fix the earth again, and as the weeds are left there for three years, they will have disintegrated afterwards. This helps improving the organic layer of the soil. So, the weeds are what helps improving the soil.

5.8 Development and Variation of the Horizon A during last 30 years by peasants

Through the direct interviews with the agriculturists you can show the improvement of soils on farms where agroforestry-systems for the coffee have been developed. This f.e. one can observe the proposal of Mr. Adelmo Munos:

> *When, 30 years ago, we bought this parcel the soils were completely yellow there were no crops at all. So we cultivate coffee in the tree´s stadows. Liming was done and slowly the soil improved. Today it is loose, brown or black and has many plants and worms. The coffee's shadows and the organic material helps to retain more water and more fertilizer. (Interview No.14. Mr.Adelmo Munos)*

Table 21: Development and variation of the Horizon A during last the 30 years by peasants

Types soil By Pesant	Development Horizon A	Frecuency	Total
Good	3 cm	44.0	72.0
	3 - 5 cm	14.0	
	> 5 cm	11.6	
	Not answered	2.3	
Bad	3 cm	11.6	14.0
	3 - 5 cm	2.3	
	> 5 cm	0.0	
	Not answered	0.0	
Igual		4.7	4.7
Not answered		9.3	9.3

Source: (Answer by Peasants n= 47)
Rivas 2003

About 70% of the surveyed agriculturists affirmed that the superficial layer of soils in the coffe culture has improved. (Table 21). 40 % of the peasants affirm that the soil has inc reased more of the 3 cm and a 14% more than 3 cm. The agriculturists stand out that the color has improved from yellow to cafe or black as a result of the organic matter incorporated by the system. The content of organic matter is the result of the balance between humification and mineralization and of the productivity of the ecosystem: The more productive is the system, as much the more vegetal remainders are in the ground. (Benzing, 2001).

When comparing the information of the agriculturists in the previous table and the Figures 9 and 10, where the improvement of the percentage of C through time has been demonstrated, with the soil analyses, it can be affirmed that it corresponds to the empirical observation by the agriculturists. They have observed the change of yellow color to brown or black, as well as an improvement of the soil's structure, a greater retention of water. Through a phenomenological apprehension it can be deduced that there's an equivalence between the peasants' observation and the scientific information, supplied by soil analyses.

5.9 Local Indicators of soil quality

The 7 local indicators of greatest importance for agricultures of the region and which are used most frequently to describe the quality of the soil, are in their order of subordination: The texture of the soil (27.8%); the color (20.8%); the indicating plants or presence of weeds (9.5%); the yield (7.7%); the organic matter (5.9%); the humidity (3.8%); the earthworm (2.5%). The previous aspect can be verified in fig 23. For the indicator texture the farmers use three different ranks, which are: dusty, sandy and crumby. The crumby texture appears most frequently in the parcels and they easily know how to identify it, because the soil of these parcels is characterized as a system of coffee with trees (Agroforesty).

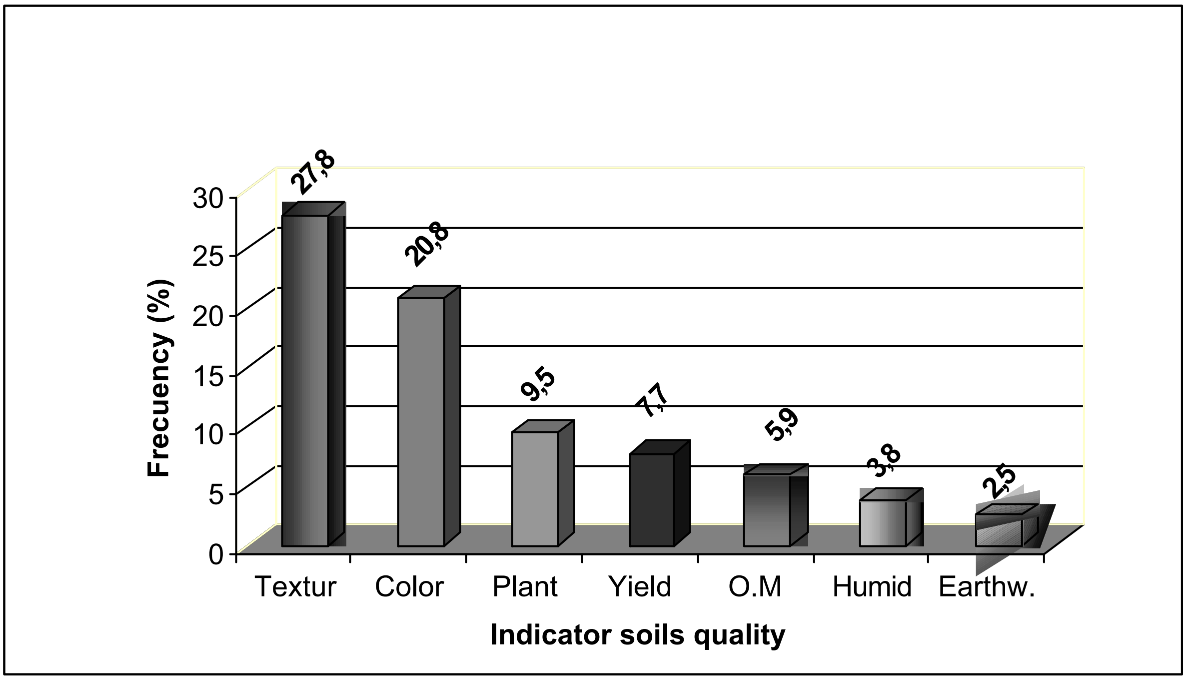


Figure 23: Hierarchic position of the Indicators of soil quality in Cabuyal Cauca, Columbien 2001

The local indicator color subdivides the colors red and yellow to describe bad soils and the colors brown and black to characterize good soils. These last ones are identified as the soils with a greater content of organic material, which means that they are more fertile. It is observed that 34.9% of the agriculturists also identified the colors brown and black as equivalent to good soil with 39.1 %. In a Brazilian study (Queiroz and Norton, 1992) data on morphological attributes (e.g., texture and color) were collected from the field and further subjected to cluster analysis leading to the conclusions that the composition of numerically derived cluster corresponded closely with the grouping of soils in accordance with the local classification. Soil texture influences crop production through other properties such as water permeability, water holding capacity, drainage, and other physico-chemical properties of soil (Talawar, 1997).

Using the plant's weeds (Indicator plants) as indicators of soil quality, in Cabuyal, it was managed to detect more than 40 different species of plants, that have been divided in two groups: those whose presence in the parcel indicates that the soils are very good and apt to be cultivated, due to their good fertility and appropriate characteristics for cultivation, and those whose presence indicates bad soils which do not let the cultures develop well.

Table 22. Hierarchy each Indicator in the Research Zone

Indicators quality soil	Colour	O.M.	Earthworm	Textur	Indicatorplantnt	Yield	Humidity
1	25.6	4.7		51.2	2.3	9.3	
2	39.5	7.0	7.0	18.6	20.9	2.3	4.7
3	4.7	14	7.0	7.0	18.6	16.3	14
4	2.3	2.3		2.3	9.3	7.0	7.0
5					2.3		

Source: Rivas 2004

Table 23: Indicators of soil quality l

Indicators quality soils	Texture	Colour	Indicatorplant	Yield	Organic matter.	Humidity	Earthworm
Rank	1	2	3	4	5	6	7
Value Indicator	27.8	20.8	9.5	7.7	5.9	3.8	2.5

The value of each indicator was calculated in the following way:

$$\text{Value Indicator} = \frac{V5*\frac{1}{1}+V4*\frac{1}{2}+...+V1*\frac{1}{5}}{\frac{1}{1}+\frac{1}{2}+...+\frac{1}{5}} =$$

Source: Rivas 2003

With the previous formula we obtain a ponderal average of each indicator, using table 22. This is the Indicator Value which appears in table 23, and is only a ponderal value, as it appeared repeatedly amongst the agriculturists, not necessarily being the same indicators for them.

5.10 Index of soil fertility

The equation of Fertility Index was realized using the chemical parameters O.M; pH ; Al P, CECe, which at the same time are the dependent variables. Furthermore there was given a ponderal value to each of them within a scale of 100%. Thus : O.M.: 30% ; Al: 25% ; pH: 20%; P: 15%, CECe: 10%. Each of the soil parameters of the general table was given three values, high, medium and low, respectively, with the aim of facilitating the program's analysis.

With the previous criteria, the technique of regression was used partly, and the estimated parameter can be seen in table 24

Table 24: Parameter estimates local Indicator for fertility index

The REG Procedure
Model: MODEL1
Dependent Variable: IF

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	10.98965	1.56995	1.91	0.0976
Error	35	28.78152	0.82233		
Corrected Total	42	39.77116			

Root MSE	0.90682	R-Square	0.2763
Dependent Mean	1.62093	Adj R-Sq	0.1316
Coeff Var	55.94464		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	**0.64315(a0)**	0.36238	1.77	0.0846
Colour	1	**0.26839(a1)**	0.14301	1.88	0.0689
O.M	1	**0.13841(a2)**	0.12424	1.11	0.2728
Earthworm	1	**-0.10333(a3)**	0.16796	-0.62	0.5424
Text	1	**0.15727(a4)**	0.14787	1.06	0.2948
Ind.Plant	1	**0.15660(a5)**	0.09353	1.67	0.1030
Yield	1	**0.06627(a6)**	0.10985	0.60	0.5502
Humedity	1	**0.11461(a7)**	0.11409	1.00	0.3220

The equation allows the quantification of the fertility index:

$$IF = a_0 + a_1 \cdot Color + a_2 \cdot OM + a_3 . Earthworm + a_4 \cdot Texture + a_5 \cdot Plans + a_6 \cdot Humedity + a_7 \cdot Yield$$

$$\mathbf{IF = 0.64 + 0.269X_1 + 0.139X_2 - 0.1033\ X_3 + 0.157X_4 + 0.0157X_5 + 0.6627X_6 + 0.1147\ X_7}$$

X_1=Color	**X_5=Indicator Plants**
X_2=Organic Matter MO	**X_6=Humidity**
X_3=Earthworm	**X_7=Yield**
X_4=Texture	**IF= Fertility Index**

The previous equation facilitates the analysis of the importance of other soil quality indicators, which can be seen in table 24.

In table 25 about partial correlations, the relation between the ecuation Fertility Index and the different indicators mentioned by agriculturists, can be observed. The following is deduced: there's a strong significative correlation between the Fertility Index and the variable Organic Matter, with values from 0.72 to 5%.

From the previous table, you can also infer that the development of the Indicator plants as indicators of soil quality, depends on the organic matter the soil has. Furthermore they are associated to the grade of humidity. One can observe the correlation coefficient referring to the equation of the fertility index, the high correlation coefficient between the variable *indicating plants* and the *fertility*, with a value of 0.90. There is also a high correlation between *humidity* and *indicating plant,* with a value of 0.75 (See Table 25)

Table 25. Correlation Index Fertility between llocal Indicators

	IF	Colour	O.M	Earthworm	Texture	Plants	Yield	Humedity
IF	1	0,29752	**0,72**	-0,20802	**0, 783**	**0,902**	0,08946	**0,7505**
		0,0527	0,1738	0,1807	0,1952	0,124	0,5684	0,1497
Colour	0,29752	1	-0,01821	-0,02697	0,06367	0,06169	0,1754	-0,1335
	0,0527		0,9077	0,8637	0,685	0,6944	0,2606	0,3934
O.M	**0,72**	-0,01821	1	-0,24608	0,00907	-0,14988	0,14161	0,24943
	0,1738	0,9077		0,1117	0,954	0,3374	0,365	0,1067
Earthworm	-0,20802	-0,02697	-0,24608	1	-0,13043	0,04444	-0,15311	-0,23268
	0,1807	0,8637	0,1117		0,4045	0,7772	0,327	0,1332
Text	**0, 783**	0,06367	0,00907	-0,13043	1	-0,02959	-0,00367	0,13019
	0,1952	0,685	0,954	0,4045		0,8506	0,9814	0,4053
Plant	**0,902**	0,06169	-0,14988	0,04444	-0,02959	1	-0,19505	0,13932
	0,124	0,6944	0,3374	0,7772	0,8506		0,2101	0,3729
Yield	0,08946	0,1754	0,14161	-0,15311	-0,00367	-0,19505	1	-0,27147
	0,5684	0,2606	0,365	0,327	0,9814	0,2101		0,0783
Humedity	**0,7505**	-0,1335	0,24943	-0,23268	0,13019	0,13932	-0,27147	1
	0,1497	0,3934	0,1067	0,1332	0,4053	0,3729	0,0783	

5.11 Local plants used by the peasants as indicator for soil quality

A number of studies in ethnopedology have indicated how subsistence farmers used different soils for raising different crops. The knowledge of soil- vegetation relationships broadly consists of use of certain plants (shrubs, grass, weed, etc.) as indicator of soil fertility and also the use of beneficial plants for enhancing soil fertility by local farmers (Talawar 1991, 1997) The peasants of the Cabuyal watershed have been identifying more than forty plants to evaluate the soil quality. In table 26 you find the indicating plants for good soils and in the table 27 the indicating plants for bad soils.
The three most important plants, according to their presence in the parcels, are: *Bidens pilosa, Emilia sanchifolia, Solanum nigrens.* These plants are identified as indicators for good soils, as they are only found in the parcels when there is sufficient humidity.

The soil's colour is brown or black, the texture is a better one. More than thirty years ago, the majority of the small holder today coffee growing- had yellow-coloured soils with less content of organic material; due to the introduction of agroforestry-system for growing coffee, the soils have improved in many of the physical and chemical characteristic, as the following interview with Mr. Edilberto shows:

> *The soil of my parcel is now darker than twenty one years ago. It has received more organic material due to the coffee cultivation with trees. Now it disposes of more humidity , it is looser, the crops are better. Apart from the fact that there are now plants, like the Papunga, lechuguilla, amor ardiente and salvia. Which indicate a fertile soil. There are also more worms in my parcel as there is more organic material and humidity.(Edilberto Achinte.)*

The previous comment shows how the peasant's knowledge is integrating, as he not only perceives one determining criterion for the soil quality, but integrates the soil quality with the agroforestal system of coffee cultures which is associated with organic matter, brown color, humidity and worms. In addition, he emphasizes the presence of these plants: Papunga (*Bidens pilosa*); Lechuguilla (*Emilia sanchifolia*) and hierbamora (*Solanum nigrenscens*) and associates them with the soil quality. About 90% of the agriculturists nemed the plants as indicators of soil quality. (See Fotos)

Affirmations like the one by the peasant Edilberto Achiante, permits to recognize that the pesants have valuable informations which must be taken into account for the investigation, as for example the planificcation of natural resources.

Table 26: Indicators Plants of Good soils

Rank order	Familia	Name in latin	Local Name	Frequence
1	**Asteraceae**	***Bidens pilosa***	**Papunga**	**30.6**
2	**Compositae**	***Emilia sanchifolia***	**Lechuguilla**	**7.7**
3	**Solanaceae**	***Solanum nigrensces***	**Hierbamora**	**3.7**
4	Commelinaceae	*Commelina difussa*	Siempre Viva	1.1
5	Graminaceae	*Eragrostis patula*	Pasto meloso	1.0
6	Euphorbiaceae	*Ricinus communis*	Higuerilla	1.0
7	Fabaceae	*Inga spectabilis*	Guamo	1.0
8	Asteraceae	*Ladenbergia oblongufolia*	Cascarillo	1.0
9	-------	*Brachiaria decumbens*	Brachiaria	1.0
10		*Impatien balsamina*	Amorardiente	1.0
11	Asteraceae	*Wedelia latifolia*	Verbena Blanca	0.9
12	Poaceae	*Oplismenus burmanii*	Conejilla	0.7
13	Gramineae	*Setaria geniculata*	Rabo de zorro	0.5
14	Tiliaceae	*Desmodium odscendens*	Pegapega	0.5
15	Urticaceae	*Urtica dioica*	Ortiga	0.5
16	Portulacaceae	*Portulaca oleracea*	Berdolaga	0.5
17	Phytolaccaceae	*Phytollaca americana*	Altusara	0.5
18	Solanaceae	*Solanum nigrum*	Hierba mora	0.3
19	Asteraceae	*Clibadium surinamensis*	Mariposo	0.3
20	Piperacea	*Piper spp*	Canotillo	0.3
21	Fabaceae	*Cytisus scoparius*	Salvia negra	0.3
22	Leguminoseae	*Trifolium incarnatum*	Trebol	0.1

Source: Rivas 2004

Table 27: Plants as Indicators of bad soil by Peasants

Rank order	Familia	Name in latin	Local Name	Frecuence
1	**Dennstaediaceae**	***Pteridium aquilinum***	**Helecho**	**19.4**
2	**Malvaceae**	***Sida rombifolia***	**Escoba**	**3.8**
3	**Poacecae**	*Imperata cilindrica*	Vendeaguja	1.5
4	**Ericaceae**	*Vaccinium mortinia*	Mortino	1.0
5	**Boraginaceae**	*Symphytum officinale*	Sueldaconsuelda	1.0
6	**Graninaceae**	*Achnatherum caudatum*	Espartillo	0.5
7	**Apiaceae**	*Anethum graveolens*	Falso hinojo	0.5
8	**Compositae**	*Lactuca serriola*	Lechuga	0.5
9	**Poacecae**		Ajenjo	0.3
10	**Verbenaceae**	*Stachytaphetta cayenensis*	Verbena	0.2

Source: Rivas 2004

Imag 1. Bidens pilosa

Imag 2. Emilia sanchifolia

Imag 3. Impatien balsamina

5.12 Local and scientific knowledge of soils

5.12.1 Comparison of chemical parameters of soils and local clasification

The comparison of the local classification of soil quality and the scientific knowledge can be observed in Table 28 and in the dendogram (Fig.26). The cluster A, the chemical properties of soils, denominated by the farmers (of good soils), are: pH-value:>5; Ct between 4 and 9%; Aluminium >1.5 meq/100g; Phosphorus available between 2.5 and 6 ppm, and CECe > 5 meq/100g. These are the best chemical properties of grounds in comparison with cluster B (tired soil) and C (bad land). They have a deep crumby texture, with good retention of humidity and coloration from brown to black.

The soils composing cluster B (Fig.24; Table 28) show the following chemical parameters: pH-value:>4.5; Ct<4%; Al< 1.5 meq/100g; P:2.5 ppm.; CECe < 3.5 meq/100g. These are red soils, with little humidity retention, and situated in slopes.

In cluster C, chemical parameters of very low values are presented, for example: pH-value: less than 3.5; Ct less than 2%; Aluminium between 1.5 and 3.5 meq/100g; Phosphorus less than 2.5 ppm; and CECe 3.5 meq/100. These soils in the subriver basin have a low soil fertility and therefore a greater tendency to erosion, as they are also more exposed to the sun.

Table 28: Relationship Between Cluster Membership and Local Classifications and Chemicales Parameter

Cluster	Local Classification	Chemicals Parameter				
		pH	Carbon	Aluminium	Phosphorus	CECe
A	Good	>5	4.0-9.0 %	<1.5 meq/100g	2.5-6 ppm	>5 meq/100g
B	Cansada (tired)	>4.5	<4 %	<1.5 meq/100g	2 ppm	<3.5 meq/100g
C	Bad	<3.5	<2 %	1.5-3.5 meq/100g	<2.5 ppm	<3.5 meq/100g

Source: Rivas 2004

In summary, the composition of numerically derived clusters corresponded closely to the grouping of soils in accordance with the indigenous classification. Thus, cluster A,B,C (Fig.24) respectively, represent the Good (Zanjon, huecada, coffee, forest); Tired (Hillside, Tired) and Bad ones of the indigenous classification.

The close correspondence between cluster composition and chemical parameters of soil classification corroborates the usefulness of the classification as a framework for objectively grouping morphologically similar soils.

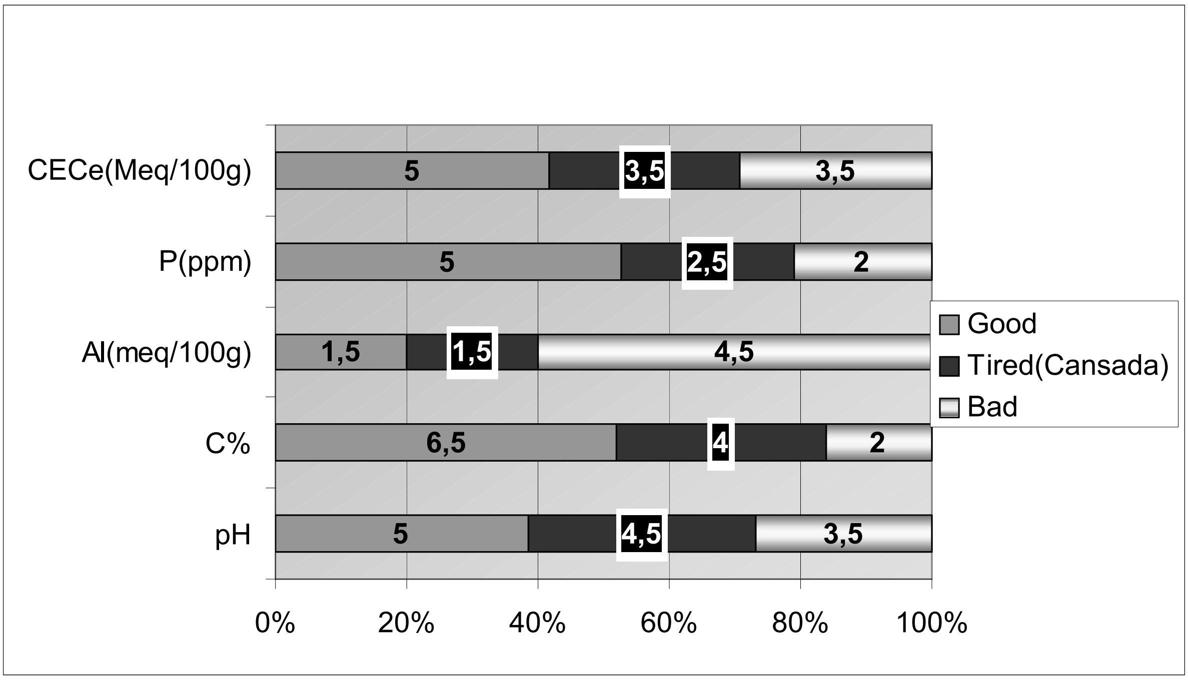


Figure 24: Frecuency (%) of the chemicals parameters in the classification of quality soil of the peasants in Cabuyal Colombia

In Fig. 24 the three clusters describing the states of pH-value, C, Al, P and CECe within the three soil types defined by the peasants (good soil, tired soil, bad soil), are resumed.

5.12.2 Comparison of chemical parameters of soil and plant indicators.l

The use of the weed's (Indicators Plant) dynamics as a measure for integrating changes of the soil, is based on the concept of natural selection. The weeds, in general, are pioneer plants, which spread out in soils of very different quality, and the predominant poblations use to associate with a group of physical, chemical and biological characteristics of the soil. As conditions change, either deteriorating or improving, the composition or amount of the weeds, composing these poblations, also changes. (Trejo Marco, 1999).

The chemical characteristics for the good soils with presence of *Bidens pilosa* is: pH-value: 5.3; Ct: 7%; Al: 3.6 meq/100g); P: 5.1 ppm; CECe: 6.85 meq/100g. By *Emilia sanchifolia* + *Bidens pilosa* is pH:4.6; Ct: 6,52; Al:1.46 meq/100g; P: 3.0 ppm; CECe: 5.9 meq/100g and with *Solanum nigrenscens*: pH: 5.2; Ct: 5.25%; Al: 1.5 meq/100g.; P: 3.34 ppm and CECe 7.56 meq/100g. (Table 29)

The three principal plants indicating good soils have been selected to observe the parameter's behaviour, as corresponding to the local criterion. With the grouping of data, a great coincidence between the agriculturist's criteria to classify soils and the results of the soil's chemical variables has been observed. Table 29 and 30. (Appendix 6)

Table 29. Relationship Between Cluster membership and Plants Indicator positive of the Peasants (Good soils)and Chemicals Parameter. Number of Farmers per Cluster given in parentheses.

Cluster	**Plant Indicator**	**Chemicals Parameter**				
		pH	Carbon (Total %)	Aluminium (meq/100g)	Phosphorus (Bray II)	CECe (meq/100g)
1	*Bidens pilosa (24)*	5.3 (A)	7.07 (m)	2.5 meq/100g (m)	5.1 ppm (m)	6.85 meq/100g (A)
2	*Bidens pilosa + Emilia sanchifolia(12)*	4.6 (m)	6.52 (m)	1.46 meq/100g (b)	3.0 ppm (m)	5.9 meq/100g (m)
3	*Bidens pilosa + Solanum nigrensces(11)*	5.2 (A)	5.25 (m)	1.5meq/100g (b)	3.34 ppm (m)	7.56 meq/100g (A)

(A) High Value

(m) Middle Value

(b) Low Value Bajo

Table 30: Simple Statistics of chemicals analysis of soil (The CORR Procedure 5 Parameters : pH Carbon Phosphorus Aluminium CECe)

			Simple Statistics			
Variable	n=	Mean	Std Dev	Sum	Minimum	Maximum
pH	43	5.02930	0.48758	216.26000	3.70000	6.20000
Carbon	43	7.43651	2.69369	319.77000	0.10000	13.00000
Phosphor	43	3.09070	2.49619	132.90000	0.54000	14.20000
Phosphor	43	1.54953	1.54953	66.63000	0.31000	4.53000
CECe	43	5.27907	2.40367	227.00000	1.66000	14.66000

The chemical characteristics for the bad soils with presence of *Pteridium aquilinum* and *Sida rombifolia* are respectively: pH-value: 3.5; C: 2%; Al: 3.6 meq/100g ; P: 1.8 ppm; CECe: 3meq/100g (Table 31).(Appendix 6)

Table 31: Relationship Between Cluster membership and Plants Indicator negative (bad soils) of the Peasants and Chemicals Parameter. Number of Farmers per Cluster given in parentheses

Cluster	Plant Indicator	Chemicals Parameter				
		pH	Carbon (Total %)	Aluminium (meq/100g)	Phosphorus (Bray II)	CECe (meq/100g)
1	***Pteridium aquilinum(33)***	3.5	2%	3.6 meq/100g	1.8 ppm	3 meq./100
2	***Sida rombifolia(14)***	4.0	2.8%	3.2 meq/100g	1.9 ppm	2.9 meq/100g

In Fig. 25 and Table 29, 31 the behaviour of the chemical parameters of soils presenting these indicating plants, can be clearly observed. Thus, in soils with *Bidens pilosa*, *Emilia sanchifolia* y *Solanum nigrensces*, better chemical characteristics are observed. In soils with *Pteridium aquilinum y Sida rombifolia*, worse chemical characteristics are found.

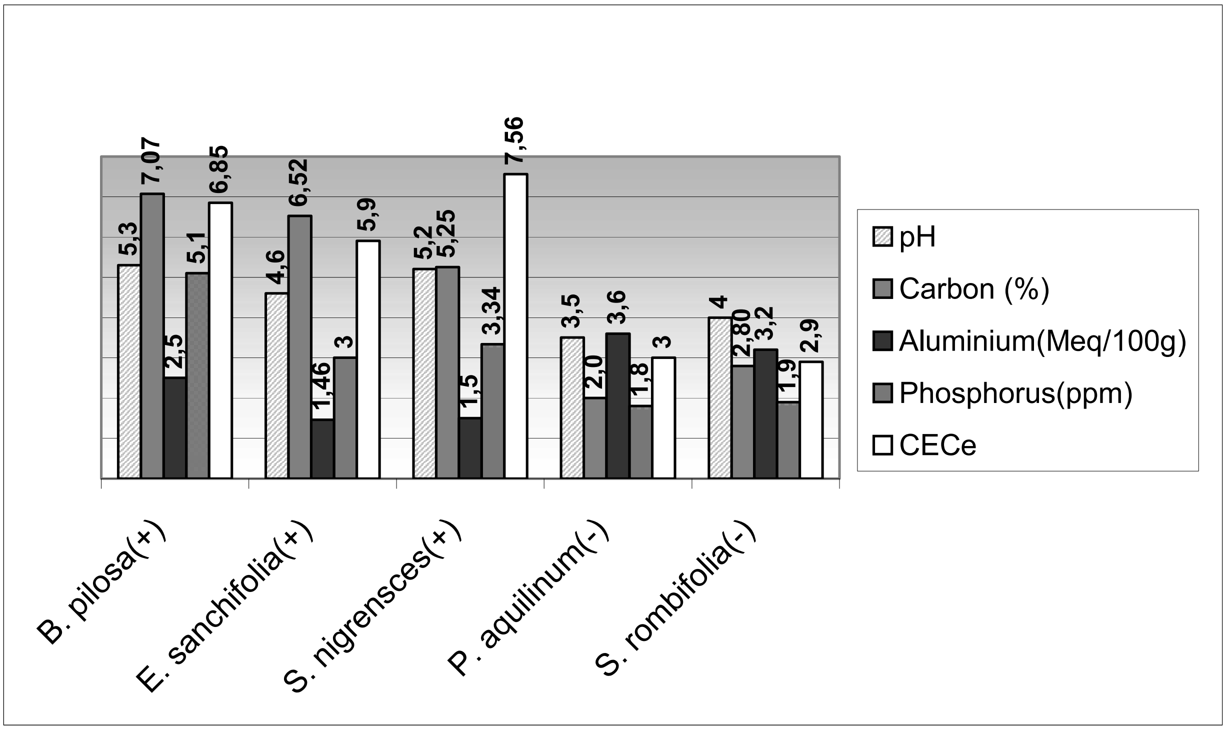


Figure 25: Situation of chemical s parameters of soil by indicator plants (Weed) in Cabuyal Colombia

5.12.3 Analysis of soil groups, according to the peasants

The multivariant analysis permits to express simultaneously the relations of all variables, without supposing a previous order. Thus, f.e., the automatic classification or analysis of clusters, are technical to explore the dates. Their aim is to see if there could be made some kind of subdivision in groups or „clusters" of the individuals (or of the variables). The instinctive idea is a group of objects or similar individuals. This type of analysis is used to: a) The description of data b) The reduction of data c) the discovery of a certain typology of data d) the generation of hypothesis, etc. (Linares, 1994)

In the dendogram Fig.26, four big representative groups of soils of the Cabuyal are presented. With the objective of making this analysis, the soil samples were classified according to the place of the fincas they had been taken from. (See Table 32)

The first group on the left, which is represented in Cluster C, consists in soils of minor quality T1 Bad, which usually are not used for plantations and which represent 11% of the samples.

The second group (Cluster B) consists in soils of minor quality, which are handled and used by agriculturists, T3 Hillside; T2 Tired; T8 Zanjon.

The third group (Cluster A) T4 Cima, which has the best quality, compared to the ones previously mentioned, and which continues the majority of good soils of the slope T5 forest and T6 coffee culture. The last group corresponds to soils of major quality due to T7, huecada and T8 of zanjón. These two last ones, where the best soils are concentrated, represent nearly 70% of the watershed's soils.

In the dendogram the number in brackets indicates the number of repetitions.
As synthesis, the analysis of the date grouping indicates that there is a coincidence between the agriculturist's criteria to characterize soils, and the results from the chemical parameters of soils, evaluated in the laboratory.

Table 32: Codes and attributes for the use dendogram (Description of treatments)

T	Types of lands	Locale name of soil
1	Bad	Bad
2	Tired	Cansada
3	Hillside	Hillside
4	Cima	Cansada
5	Forst	Good
6	Coffee	Good
7	Huecada	Good
8	Zanjon	Good

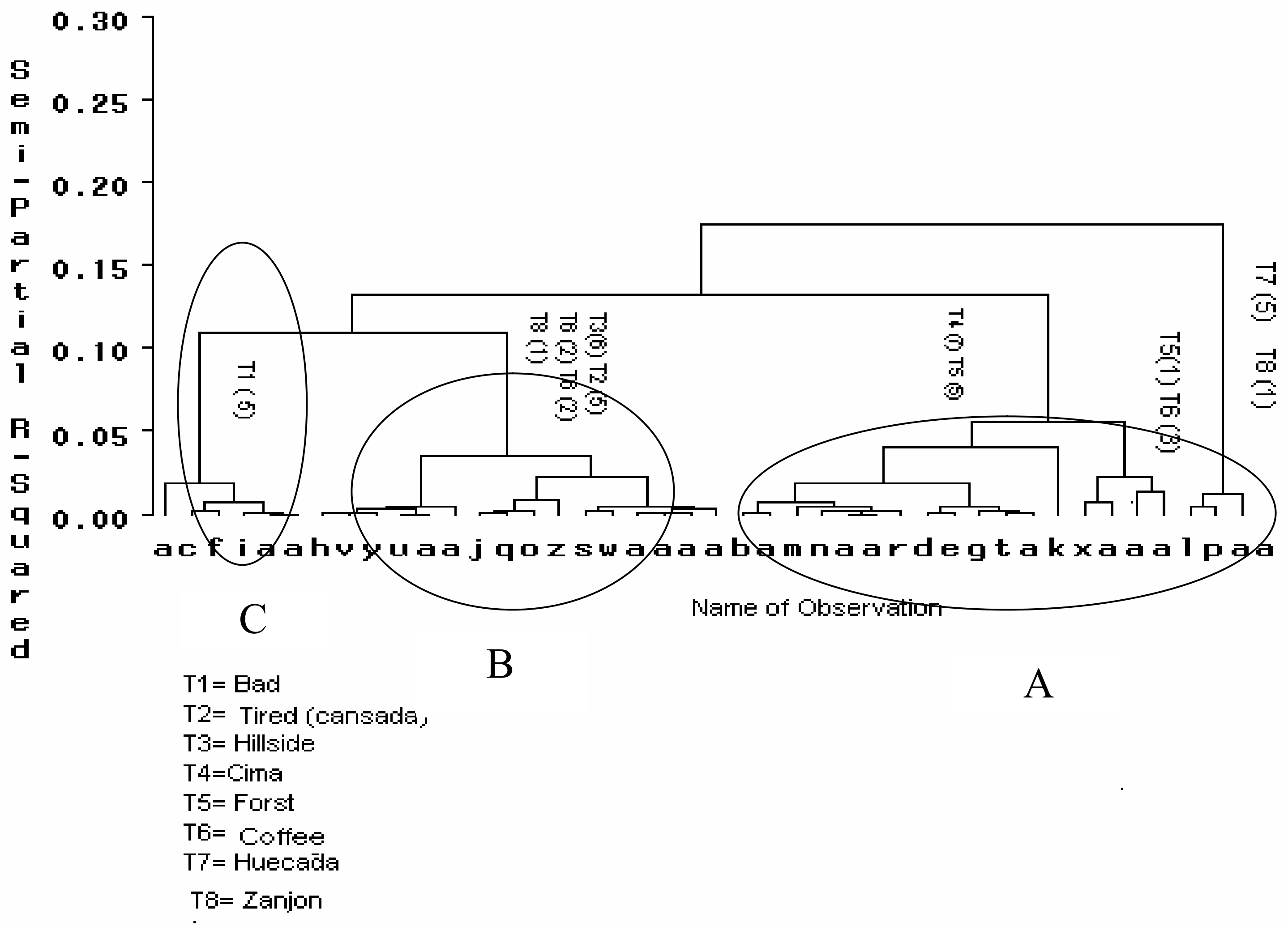


Figure 26: Dendogram of soil units in Cabuyal Colombia

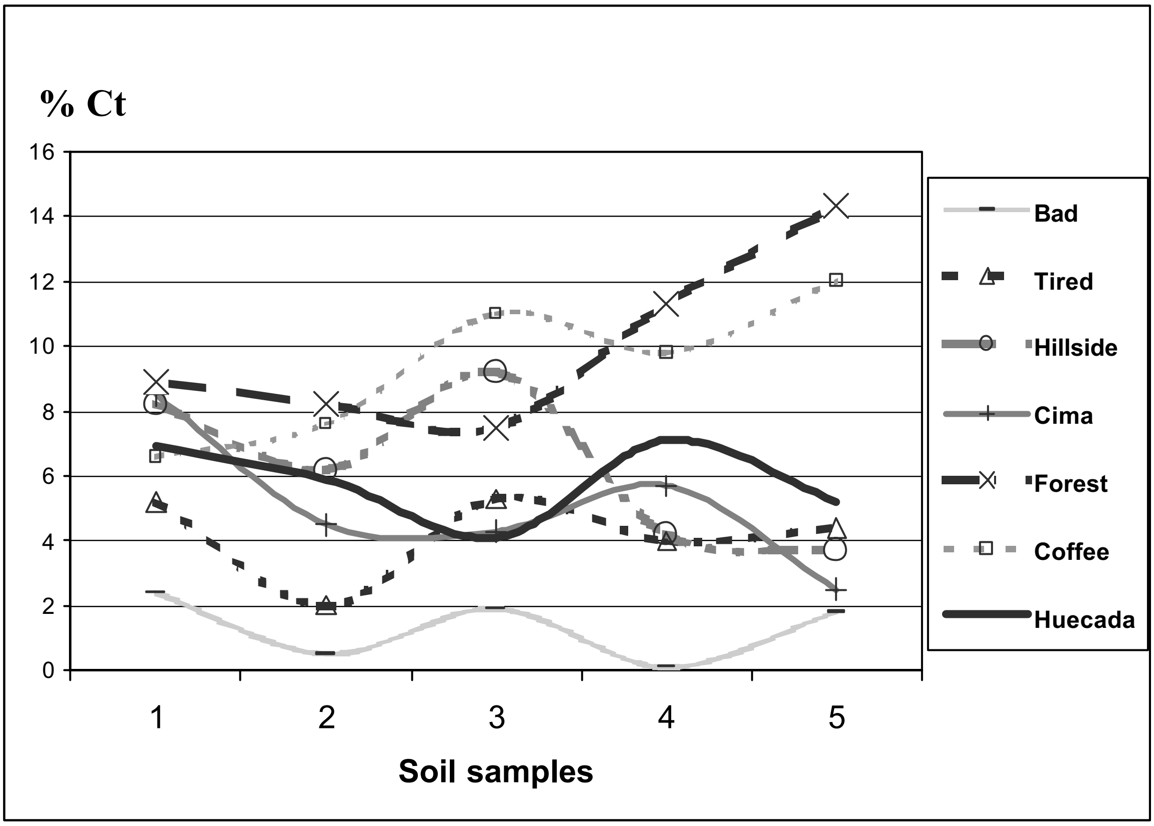


Figure 27: Situation of total Carbon (Ct) in differets soil units, Cabuyal Colombia 2001

In Fig.27 the behaviour of carbon can be observed, judging by the soil samples taken from each type of soil in the study zone. It is shown that soils with coffee cultures have a major carbon content (forest).

A low total Carbon content is found for those soils denominated bad (generally eroded), Tired; Cima. This graph permits to observe the behaviour of the type of soils seen in the dendogram of Fig. 26.

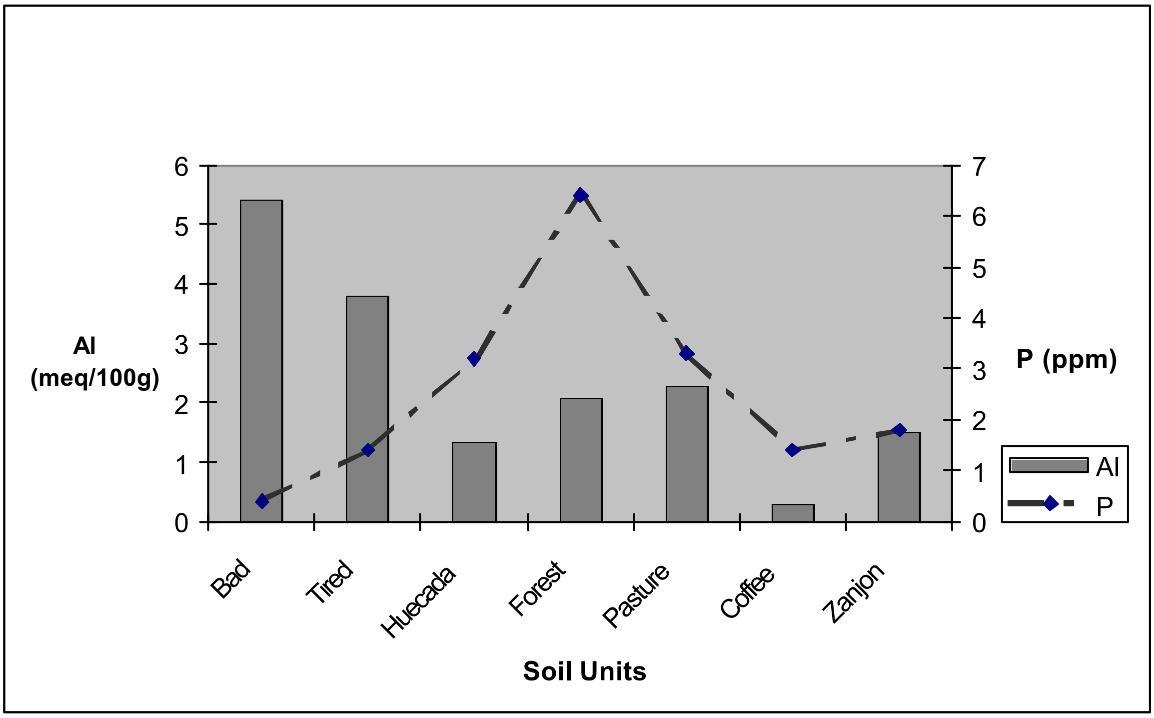


Figure 28: Inverse correlation between Aluminium and Phosphorus of Soils in Cabuyal 2001

The different types of soil of Cabuyal, from bad to good ones (according to the equivalence of the two scientific systems and the local knowledge), show in Fig. 28 the inverse correspondence between the values of high Aluminium and low Phosphorus. According to a study of 15 soils in the Andine zone, the adsorption of Phoshorus was tightly related to the content of exchangeable Aluminium, the pH-value and the organic matter (De Brito, 1975).

5.13 Importance of the local soil classification

Based on the knowledge that different kinds of land require different management strategies, the peasants in Cabuyal use an indigenous soil classification to help them communicate and make decisions of farm management. The classification reflects their management needs and the perception of environment.

Peasants, however, use not only physical-chemical soil properties as they understand them, but also a range of agro-ecological and sociocultural dimensions as basis to classify soils (Talawar, 1997).

For the peasants, the main criteria for soil quality are based on phenomenological characteristics, and are according to their order: texture, colour, presence of weeds, yield, organic matter, humidity, earthworms.

The local soil classification is more precise for the peasants, as they thus can differentiate better the soil quality. Apart from that, it is a very important tool to have their territorial use planned in a better way, together with non-governmental organizations, as well as those of the State's agricultural development.

The use of plants (presence of weeds) as indicators, and the local perception of their land, presented an excellent correspondence concerning the chemical soil parameters. This allows to affirm that there is indeed a correlation between the peasants' and the scientific knowledge, validating the hypothesis of this research project.

Traditional environmental knowledge is a body of knowledges and beliefs, transmitted through oral tradition and first-hand observation. It includes a system of classification, a set of empirical observations about the local environment. And a system of self-management that governs resource use. Ecological aspects are closely tied to social and spiritual aspects of the knowledge system. The quantity and quality of traditional environmental knowledge varies among community members, depending on gender, age, social status, intellectual capability, and profession (hunter, spiritual leader, healer, etc.). Being rooted firmly in the past, traditional environmental knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technological and socio-economic changes of the present. (Alan, R. Emery and Associates,1997).

6. Soil planning, conservation and local participation

Soil is a finite and dynamic living resource that acts as an interface between agriculture and the environment and is vital to global function. Soil health can be defined as the continued capacity of soil function as a vital living system, within ecosystem and land use boundaries, to sustain biological productivity, maintain the quality of air and water environment, and promote plant, animal and human health. Advantages to give value to soil health and its assessment include: (i) importance as a resource for evaluation of land-use policy, (ii) use in identification of critical landscapes or management systems, (iii) use in evaluation of practices that degrade or improved the soil resource and (iv) utility for identify gaps in our knowledge base and understanding of sustainable management (Doran, 1997)

From an agroecological view, there are two fundamental elements to take into consideration for the conservation of tropical hill soils. These are:

- The participation of the peasants'knowledge in the process of regional planning.
- The agronomic criteria from an agroecological perspective.

For this reason, any proposal of soil conservation that doesn't take into consideration the agriculturists, as technological innovator and active agent within the process, tends to fail. That's why the peasants should participate in a capacitating plan between institutions, governmental or non-governmental, where a vertical flow of information within the process of planning and implementation of the soil protection. The peasants, the local community, are the ones who finally decide about what happens on their parcels, according to their familiar, agricultural climatic and economic necessities. The assessors pertaining to the institutions (NGOs or State organizations) will act as transformators of the agriculturists' procedures concerning: identification and order of problems and possibilities; The research for solutions; the planning of actions, the implementation of decisions that have been taken together; the monitoring and evaluation of the activities and the exchange and adjustment of future actions.

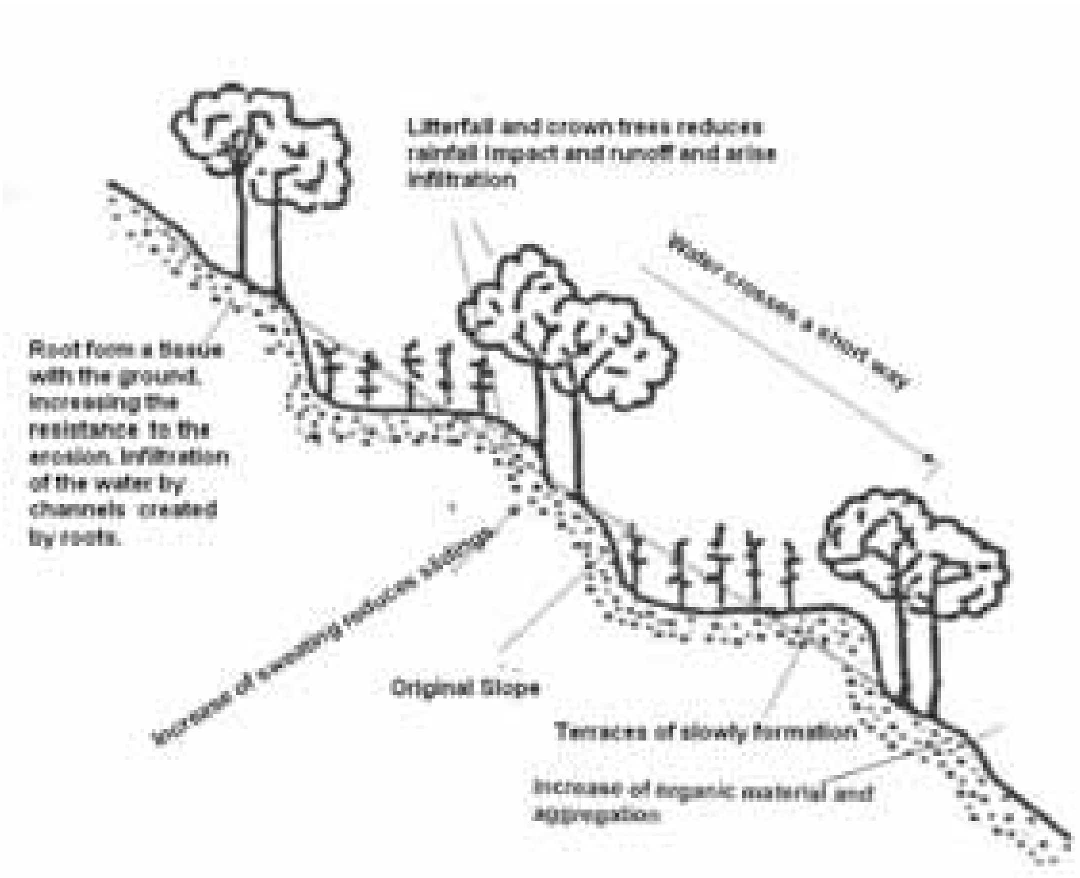
From the technical point of view, the degradation of soils is initiated with the impact of tropical rain and the strong radiation of the sun on the soil's surface. For this reason, the effect of the hydric erosion is reduced by increasing the soil's vegetal cover (a cover of 40-50% of the surface, can reduce the effects of *pattering* by 90% (Müller,1997) and improve the water's infiltration, while the physical practices are considered secondary.

These agroecological practices of soil conservation, apart from being simple, are cheap and improve the land's productivity, and the following ones can be enumerated:

· Increase of vegetal cover (policultural, agroforestry systems)
· Increase of water's infiltration (Mulch, Compost, Agroforestry System)
· Control of *run- off* and reduction of the pendant (living barriers, agroforestry -system)
· Participation of the agriculturists in the whole planning process
· The watershed as planning unit shall figure as reference

6.1 Agroforestry

Agroforestry is the growing of both trees and agricultural / horticultural crops on the same piece of land. They are designed to provide tree and other crop products and at the same time protect, conserve, diversify and sustain vital economic, environmental, human and natural resources. Agroforestry differs from traditional forestry and agriculture by its focus on the interactions amoung components rather than just on the individual components themselves.



Source: Kuchelmeister 1990

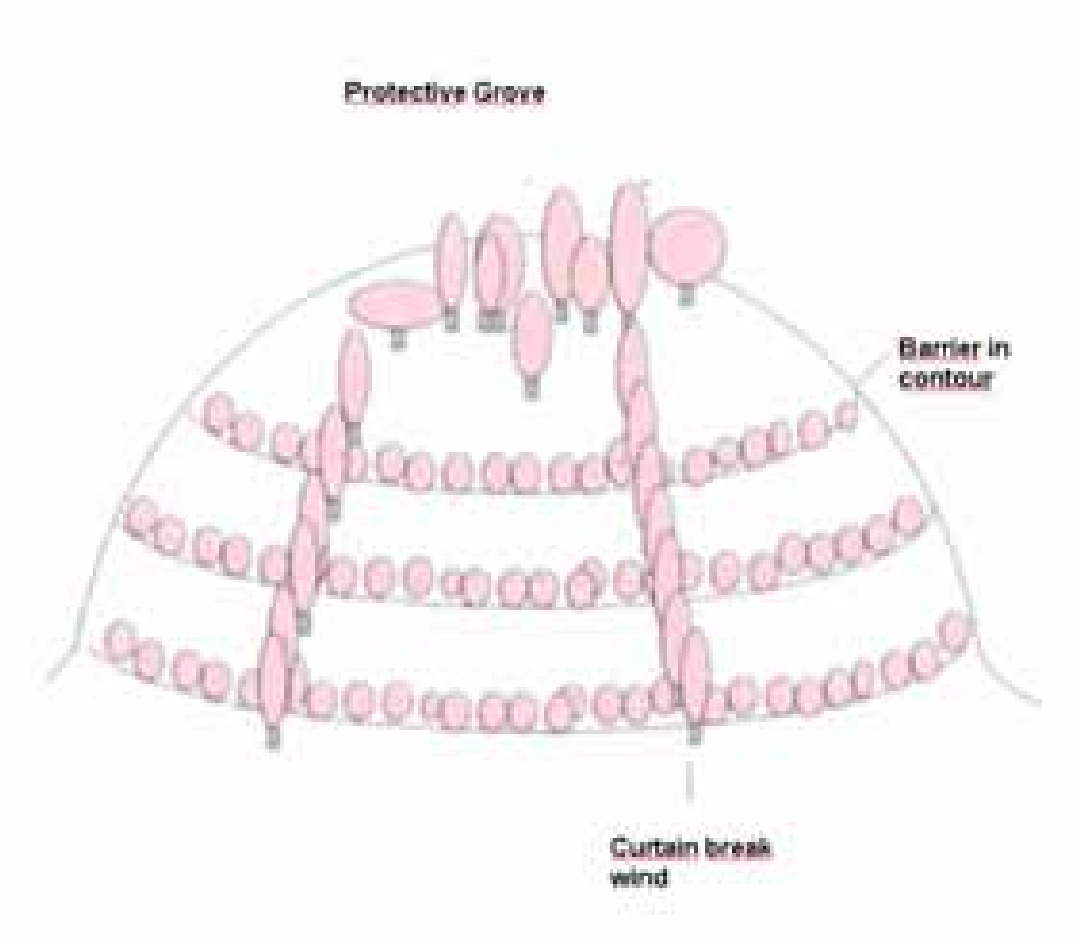
6.1.1 Benefits of agroforestry

Research has also confirmed that agroforestry systems can include the following benefits: See Grap.

- They can control runoff and soil erosion, thereby reducing losses of water, soil material, organic matter and nutrients.
- They can maintain soil organic matter and biological activity at levels satisfactory for soil fertility. This depends on an adequate proportion of trees in the system - normally at least 20% crown cover of trees to maintain organic matter over systems as a whole.
- They can maintain more favourable soil physical properties than agriculture, through organic matter maintenance and the effects of tree roots.
- They can lead to more closed nutrient cycling than agriculture and hence to more efficient use of nutrients. This is true to an impressive degree for forest garden/farming systems.

- They can check the development of soil toxicities, or reduce existing toxicities - both soil acidification and salinization can be checked, and trees can be employed in the reclamation of polluted soils.
- They utilise solar energy more efficiently than monocultural systems - different height plants, leaf shapes and alignments all contribute.
- They can lead to reduced insect pests and associated diseases.
- They can be employed to reclaim eroded and degraded land.
- They can create a healthy environment - interactions from agroforestry practices can enhance the soil, water, air, animal and human resources of the farm. Agroforestry practices may use only 5% of the farming land area yet account for over 50% of the biodiversity, improving wildlife habitat and harbouring birds and beneficial insects which feed on crop pests. Tree biodiversity adds variety to the landscape and improves aesthetics

Contour buffer strips are basically rows of trees (and sometimes shrubs) in rows along contours, with alleys between for forage or alley cropping. The aim is to reduce soil erosion on slopes and give some wind protection.



Source: Benzin 2001

Fertility plantings are plantings of trees and/or shrubs with the main aim of improving nutrient input and/or cycling for a forage or alley crop. Nitrogen-fixing trees and shrubs are usually used, for example Italian alder, Elaeagnus, Sea buckthorn, and Black locust. Nitrogen fixed by bacteria in association with their roots is made available to other crops via leaf fall, rain drip, root-root contact and beneficial fungi. The amounts made available are in the same order as from perennial legumes.

7. Conclusions

Local information and peasants interview allow scientists to identify the soils that are important to farmers, determine each soil's relative productivity, and locate typical examples of each soil. Benefits for development and planning include production of soil maps on scale that is more appropriates to peasants production, a better understanding of the rationale behind management practices and the type of soil information that would help farmers, better communication between farmers and western soil scientists or extension agents who can tap into local soil terminology, and better correlation of information between regions too increase the capacity for local-level problem solving.

Beginning agricultural development work with indigenous soil classification systems can make research and development efforts more effective and economically efficient.

Management of soil depends, not only on biophysical soil properties but also on factors such as seasons, crop rotation, weather conditions, availability of labour, subsistence requirement and marquet.

For agricultural research, extension personnel. And consultants, finding from this study show the benefits associated with asking peasants about the characteristics of their soils as first interaction to- peasants point- scale evaluation of soil quality.

Soil quality in the Cabuyal zone

The farmers, cultivating coffee-agroforestry systems since 30 years (with compost, mulch and poultry dung), had identified 70-80% of their soils with improved A-horizon by the local indicators. This correlates scientifically with the increase of available nutrients (laboratory analyses) such as Ct, P (Bray II), CECe and soil structure.

In general, the watershed's soils can be defined chemically as acid, deficient in phosphor, with medium contents of organic carbon, which diminishes as the watershed's hight descends.

The soil which is found in the agroforestry-system of coffee, has been improving due to the incorporation of biomass, increasing the level of organic matter and the disposal of nutrients; additionally the traditional coffee culture protects the soil from fluvial erosion, and from the impact of the high insolation.

The results of this study indicate the fundamental aspects about peasants' local knowledge, concerning slope agriculture. They can determine the differences between the soils, in terms of *content of organic matter, texture, retention of humidity* and *indicating plants.*

Judging by references, associated to the relief and soil's characteristics, such as color, structure, texture, humidity, upper horizon, presence of earthworms, presence of certain indicating plants, the peasants of the zone are able to determine the quality of their soils very well. The local cultural categories, as defined by the peasants, good, tired and bad soil, make sense as they name the location of the soil, its characteristics and their own experience with the handling and use of it. Besides that, they take the local vegetation, such as the macroinvertebrates, into consideration.

Due to the lack of confidence and respect, concerning the peasants' knowledge, there's much insecurity while trying to gather objectively empirical information. One reason for this is also the institutions' or research scientists' aim to prove or validate some kind of hypothesis, or to transfer a technology without understanding the whole cultural context of the time and space handled by the agriculturists. Finally, its them who implement measures of protection for their resources (The Soil) in the last instant.

There is a good equivalence between the evaluation system of soil quality, used by the agriculturists in this watershed, and the physical-chemical parameters of soils, studied in the laboratory.

Within the community, there are leaders with a knowledge about the problems and practices of soil conservation. With their experience, they constitute a human resource of the watershed to generate a conservation program for its soils.

The peasants have a huge knowledge, concerning their soils, to evaluate their quality and fertility. This is a result from daily and direct observation of the soil. Such a knowledge must be taken into consideration when planning the soil's use, or projects of development or research together with the peasants. For example there's a big project of water and agricultural development, led by the ministry of agriculture and the CIPASLA.

The agriculturists of the watershed use their traditional knowledge rather than chemical soil analyses, to evaluate the soil´s quality. For them, the most important indicators are: the texture, the colour, the indicating plants, the harvest, the humidity and the presence of worms.

Multivariate analyses and grouping of dates constitute a valuable tool for statistics, when trying to combine variables of quantity as well as of quality. Thus, f.e, the grounds have been organized in the same manner the watershed's peasants considered.

The plants used by the agriculturists to evaluate the soil quality, correspond with the physics-chemicals evaluations of the laboratory.

The present study of investigation is an approach to the dialogue between scientific knowledge and the peasants. It is held within a frame of interdisciplinarity, as this allows a holistic comprehension of the problems and the reality concerning the resource soil.

8. Summary

The present study with the title „ *Estimation and evaluation of plants as indicators of tropical soils quality from the knowledge of the peasants, Cauca Colombia.*“ tries to contribute to the integration of local knowledge about soils by the peasants. The field work took place in the watershed of the Río cabuyal, department of Cauca, in the southeast of Colombia. This is a region, which is characterized by small farmers.

In the first chapter, the objectives and hypothesis of the investigation are determined. In the Revision of Literature, the global function of soil and its sustainability are exposed. Also, the importance of investigating new living indicators, as these integrate chemical, physical and biological aspects to determine the soil's quality, and the participation of the agriculturists concerning the investigation of soil quality.

The methodology describes the geographical zone of study and the socioeconomic characteristic's of the watershed's agriculturists.

The field and Lab Methods expose the main field activities, where the following information was gathered:

1. Recollection of agriculturists‘ knowledge, through a survey and direct interviews.
2. Evaluation of soil analyses by the secretary of agriculture of the department, during the last 30 years. Furthermore determination of the behaviour of the main chemical indicators of soil quality. Also recollection of soil samples from each agriculturists‘ farm where the interview took place, to see the present state of the soil.
3. Recollection of more than 40 types of weeds, which are used as local indicators of soil quality by the agriculturists.
4. More than 300 soil samples, georeferenced by GPS in eight different soil types, according to the farmer's criteria, with 6 repetitions for a total of 47 different farms, in a depth of 20 cm.

The samples were analized in the soil laboratory of the „Centro Internacional de Agricultura Tropical" (CIAT), where organic matter, pH, % carbon total, potassium, calcium, magnesium, color and texture were determined.
The quantitative information was exposed with descriptive statistics, analyses of frecuency, simple and composed correlations and analyses of variance.

Later on, qualitative and quantitative variables have been correlated to see if there is an equivalence between the quantitative analyses and the qualitative information, given by the agriculturists. The multivaried analysis, with main components was a tool which helped to combine these variables.

The Results and Discussion are divided in five parts: The first part is a description of the use of soil in the watershed. The second one is a quantitative determination of the the main chemical soil indicators behaviour during the last 30 years. The third part is a description of the different classifications of soils by the peasants, where their most important testimonies are gathered. The fourth part is a description of the main weeds used by farmers as indicators of fertility or degradation of the soil. The fifth is the combination of quantitative variables of soil analyses and indicating plants, with the information supplied by the agriculturists, where a strong correspondence between the local and the scientific knowledge can be observed. Taking into account this order, the main results of the present investigation are as follows:

⇒ The coffee culture is most important in the region for economic reasons as well as due to its extension. The peasants show that the coffee with shady supports: the use, the humidity, the amount of shade, the association with insects, the leaves and the root.

⇒ Referring to corresponding amount of land dedicated to agricultural products, it is estimated that 36.8 % of the agricultural area is for coffee culture; 9.1 % for bean; 7.7 % for fruits; 6.4 % for cassava culture; 3.0 % for maiz and 2.4% for sugar cane.

⇒ After some time, it can be observed that (Ct) tends to increase slightly from 4,5% in 1972 to 6.4% in 2001.The correlation coefficient (R^2=0.50); phosphorus (P) increases from 0.70 ppm. to 6.00 ppm; the improvement of the CECe of 1972 in 2.6 meq/100g to 4 meq/100 in 2001; The Calcium (Ca) average increase from 0.30 meq/100g to 2.20 meq/100g has been observed; The Magnesium (Mg) between 1970 and 1980 its value was 0.4

meq/100g; between 1991 and 1997 it was 0.9 meq/100; Aluminum Saturation (Al) tends to decrease from 73% in 1972 to 28.% in 2000. Nonetheless the correlation coefficient (R^2=0.70).

⇒ Two big groups of soil classification were found : the soils classified by specific qualities and cultural categories.

Specific soil qualities: These soil s have a specific attribute and they name them by a qualifying adjective (Black Soil; Red Soil; Ceruda (Sticky) soil; Suelta(loose) Soil; Granosa Soil- Polvosa; Humid Soil- dry Soil; Hill soil- Plane.)

Cultural categories: is not only characterized by the soil´s properties, but by the form and sense the agriculturists give them through the following aspects: combinations and integration of various specific qualities of the soil, location, the peasant´s daily experience, observation of the vegetation, and the soil´s transformations **(**Good Soil; Bad Soil; Tierra cansada (tired land))

⇒ The categories are not fixed, static, through time and there is no unique definition for each cultural category used by all the peasants because they have a dynamic use. Therefore the peasants give them form, according to their context, and combining different references, such as the location, the experience with the use and handling of soils, the recognition of some plants, etc.

⇒ The 7 local indicators of greatest importance for agricultures of the region and which are used most frequently to describe the quality of the soil, are in their order of subordination: The texture of the soil (27.8%); the color (20.8%); The indicating plants or presence of weeds (9.5%); the yield (7.7%); the organic matter (5.9%); the humidity (3.8%); the earthworm (2.5%).

⇒ The three most important indicating plants of good soil, according to their presence in the parcels, are: *Bidens Pilosa, Emilia sanchifolia, Solanum nigrens.* And the two most important indicating plants of bad soils are: *Pteridium aquilinum* and *Sida rombifolia*

⇒ The three principal plants indicating good soils have been selected to observe the parameters` behaviour, as corresponding to the local criterion. With the grouping of dates, a great coincidence between the agriculturists' criteria to classify soils and the results of the soils' chemical variables has been observed. pH-value: 5.3; Ct: 7 %; Al: 3.6 meq/100g; P:5.1 ppm; CECe: 6.85 meq/100g. By *Emilia sanchifolia* + *Bidens pilosa* is pH:4.6; Ct: 6.52; Al:1.46 meq/100g; P: 3.0 ppm; CECe: 5.9 meq/100g and with *Solanum nigrenscens*: pH: 5.2; Ct: 5.25 %; Al: 1.5 meq/100g.; P: 3.34 ppm and CECe 7.56 meq/100g.

⇒ The chemical characteristics for the soils with presence of *Pteridium aquilinum* and *Sida rombifolia* are respectively: pH-value: 3.5; Ct: 2 %; Al: 3.6 meq/100g; P: 1.8 ppm; CECe: 3 meq/100g.

⇒ The multivariant analysis permits to express that three big representative groups of soils of the Cabuyal are: The first group on the left, which is represented in Cluster C, consists in soils of minor quality T3 brave, which usually are not used for plantations and which represent 11% of the samples. The second group (Cluster B) consists in soils of minor quality, which are handled and used by agriculturists, T2 tired and T3 falda .The third group (Cluster A) T4 Cima , which has the best quality, compared to the ones previously mentioned, and which continues the majority of good soils of the slope T5 forest and T6 coffee culture. The last group corresponds to soils of major quality due to T7 de huecada and T8 de zanjón. These two last ones, where the best soils are concentrated, represent nearly 70% of the watershed's soils.

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10. Appendices

Appendix 1: Questionnaires used as guide for soil quality with peasants in Cabuyal 2001

CUESTIONARIO GENERAL PARA LA CALIDAD Y SALUD DEL SUELO SUBCUENCA RIO CABUYAL

Nombre____________________ Fecha__________

Vereda____________________ Coordenadas__________

Área de la Finca________________ Tenencia__________

1.- Qué Cultiva (Uso del Suelo)

Café____ Pastos____ Fríjol____ Yuca____

Caña____ Frutales____ Maíz____

Sistema Agroforestal ○ Sistema Monocultivo ○

2.-Hay alguna relación entre la salud del suelo y las plantas, animales o ser humano?

Si ○ No ○

3.-Hay alguna relación entre la calidad del suelo y alguna parte descriptiva de las plantas?

Si ○ Cuáles__________ No ○

4.-Cómo sabe usted que un suelo es sano o fértil?

Color: Rojo ○ Café ○ Amarillo ○ Negro ○

Pendiente: Plano ○ Ligera ○ Pendiente ○ Muy pendiente ○

Animales: Lombriz ○ Arañas ○ Cucarrones ○ otros ○

Textura: Polvosa ○ Arenosa ○ Grumosa ○

Cosecha: Buena ○ Regular ○ Mala ○

5.-Qué tan importante es la textura en la calidad del suelo?

Alta ○ Moderada ○ Nula ○

1

5.2.- Qué características presenta la textura de su suelo

[illegible]	[illegible]	[illegible]
◯	◯	◯

6.- Apariencia de la Raíz de las Plantas

6.1. Qué nivel de importancia tiene la apariencia de la raíz en su relación con la calidad del suelo?

Alto	Mediano	Bajo	Nulo
◯	◯	◯	◯

6.2. Describa la apariencia de la raíz y su relación con la salud del suelo. Explique las características de la raíz y el nivel de la salud del suelo

DESCRIPCION DE LA RAIZ	Salud del suelo: Alta	Baja
Delgada	◯	◯
Color de raíz	◯	◯
[illegible]	◯	◯
[illegible]	◯	◯
Desarrollada	◯	◯
Raíz larga	◯	◯
[illegible]	◯	◯
Pocas [illegible]	◯	◯
Pequeña	◯	◯
[illegible]	◯	◯
[illegible]	◯	◯

7.- Qué tipo de abono y/o fertilizantes usa?

[illegible]	[illegible]	[illegible]	Químico	[illegible]
◯	◯	◯	◯	________

2

8.-DESARROLLO DE LA CAPA DEL SUELO

8.1.- Cómo ha sido la evolución de la calidad del suelo en los últimos 20 años?

Mejor ◯ Peor ◯ Igual ◯

8.2.- Ha aumentado

3 cm ◯ 3-5 cm ◯ >5cm ◯

8.3.-Ha disminuido

3 cm ◯ 3-5 cm ◯ >5cm ◯

9.- Qué prácticas de protección y recuperación del suelo tienen ustedes?

9.1.- Ninguna ◯ 9.2 Terrazas ◯ 9.3. Barreras Vivas ◯ 9.4. Coberturas ◯

9.5.- Zanjas ◯ 9.6 Rotación ◯ 9.7 Barbecho ◯ 9.8 Acequias ◯

9.9 Curvas a Nivel ◯ 9.10 .Cultivos asociados ◯ 9.11 -Otros ______

10.- Considera usted las plantas como indicadoras de fertilidad o salud del suelo?

SI ◯ NO ◯

11.- Que plantas le indican suelos buenos y por que?

______

12.- Qué plantas le indican suelos malos y por qué?

______

13.-Clasifica su finca con diferentes tipos de barbechos? Cuales

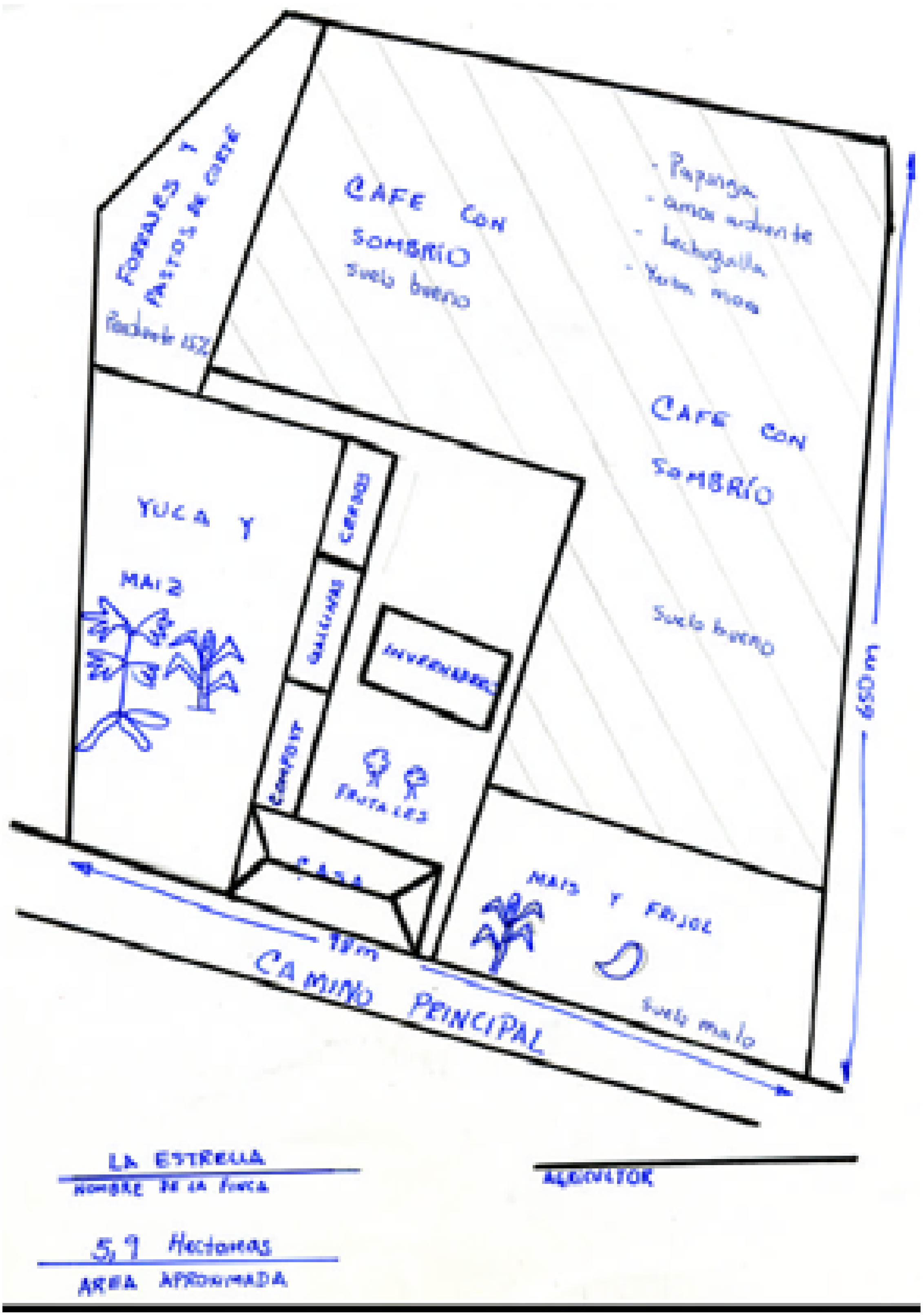
______

14.- Principales parámetro químicos de suelos

M.O.____ P____ K____ Ca____ Mg____ Sat Al.____ CIC____ pH____

3

Appendix 2: Maps and distribution of the farmers



Appendix 3: Data Bank of soils sample in diferent units soil 2001

Tratamiento	Percepción Local	Zona de la Finca	Parametro químico				
		Tratamientos	PH	C	Al	P	CICE
T1	Brava	Barbecho T1	5,00	2,40	5,40	0,40	5,68
T1	Brava	Barbecho	5,2	0,5	1,87	0,69	3,16
T1	Brava	Barbecho	4,8	1,90	3,33	0,97	4,21
T1	Brava	Barbecho	4	0,1	4,53	0,54	5,4
T1	Brava	Barbecho	4,90	1,80	4,49	0,88	5,44
T1	Brava	Barbecho	4,80	1,50	4,30	0,99	5,50
T2	Cansada	Barbecho	5,30	5,20	0,62	0,69	2,96
T2	Cansada	Barbecho	5,50	2,00	0,52	4,40	5,08
T2	Cansada	Barbecho	5,50	5,30	0,15	0,59	5,75
T2	Cansada	Barbecho	5,00	4,00	0,77	2,15	3,70
T2	Cansada	Barbecho	5,00	4,40	1,04	1,20	3,12
T3	De Falda	Potero	5,40	8,20	0,77	0,82	5,69
T3	De Falda	Potero	5,30	6,20	1,14	1,40	4,03
T3	De Falda	Potero	5,40	9,20	0,31	3,50	9,11
T3	De Falda	Potero	5,00	4,20	0,42	0,70	2,10
T3	De Falda	Potero	5,10	3,70	0,62	1,40	3,04
T4	Loma alto	Potrero	5,20	8,50	0,73	2,27	2,39
T4	Loma alto	Potero	5,10	4,50	1,66	1,10	3,40
T4	Loma alto	Potero	4,80	4,30	1,35	3,20	4,16
T4	Loma alto	Potrero	5,20	5,70	0,31	0,56	3,22
T4	Loma alto	Potero	4,80	2,50	0,73	2,40	2,95
T4	Loma alto	Potero	4,00	3,30	1,10	2,00	3,00
T5	Buena	Barbecho(Zanjón)	3,80	13,20	6,98	1,76	8,71
T5	Buena	Barbecho(Zanjón)	3,90	4,40	2,29	3,50	6,06
T5	Buena	Barbecho(Zanjón)	4,10	10,80	4,33	2,74	7,22
T5	Buena	Barbecho(Zanjón)	3,70	6,20	3,22	11,70	6,63
T5	Buena	Barbecho(Zanjón)	4,20	10,60	3,12	1,25	4,97
T6	Buena	Bosque	4,00	6,80	3,12	0,94	3,99
T6	Buena	Bosque	3,80	8,90	5,97	3,90	7,73
T6	Buena	Bosque	4,00	8,20	3,85	1,22	5,07
T6	Buena	Bosque	4,00	7,50	4,58	1,60	5,53
T6	Buena	Bosque	4,30	11,30	2,08	0,68	3,46
T6	Buena	Bosque	4,90	14,30	3,00	1,03	4,00
T7	Buena	Café Huecada	3,80	6,90	3,85	8,89	6,52
T7	Buena	Café Huecada	4,00	5,90	2,09	6,40	7,97
T7	Buena	Café Huecada	3,90	4,10	2,39	3,18	6,02
T7	Buena	Café Huecada	4,00	7,10	2,29	3,30	7,93
T7	Buena	Café Huecada	3,60	5,20	5,72	6,06	7,62
T8	Buena	Café	4,10	6,30	2,50	1,86	4,20
T8	Buena	Café	4,40	6,60	0,94	1,04	5,97
T8	Buena	Café	4,00	7,60	0,31	1,40	4,57
T8	Buena	Café	4,30	11,00	1,56	0,91	4,77
T8	Buena	Café	4,20	9,80	3,22	1,15	4,76
T8	Buena	Cafe	4,90	12,00	2,00	1,10	4,20

Appendix 4: Soil Sample (Data bank CIAT and Secretary Agriculture) 1970-2000

No.	FECHA	SOLICITANTE	VEREDA	ALTURA	PH	ARENA	LIMO	ARCILLA	TEXTURA	MO	N	C_N	P	CA	MG	K	NA	CIC	AL	ZN	FE	CU	MN	B	CO	MB	SAT_AL
1	04.11.69	ARCADIO FERNANDEZ	20 DE JULIO	1726	5,00	0,00	0,00	0,00	FRANCO ARCILLOSO	5,70	0,00	0,00	2,80	0,00	0,00	0,32	0,00	0,00	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
2	27.11.90	GUSTAVO FERNANDEZ	20 DE JULIO		4,00	0,00	0,00	0,00	FRANCO ARENOSO	14,40	0,00	0,00	3,00	0,60	0,20	0,31	0,00	0,00	3,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
3	27.11.90	GUSTAVO FERNANDEZ	20 DE JULIO		4,20	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	8,60	0,00	0,00	3,00	1,60	0,90	0,42	0,00	0,00	2,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
4	27.11.90	GUSTAVO FERNANDEZ	20 DE JULIO		4,30	0,00	0,00	0,00	FRANCO ARENOSO	10,70	0,00	0,00	3,00	0,60	0,30	0,39	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
5	07.10.94	IVAN VALENCIA	20 DE JULIO		5,10	0,00	0,00	0,00	FRANCO ARENOSO	17,20	0,00	0,00	1,00	1,30	0,70	0,32	0,00	0,00	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
6	07.10.94	IVAN VALENCIA	20 DE JULIO		4,90	0,00	0,00	0,00	FRANCO ARENOSO	20,90	0,00	0,00	1,00	1,30	0,60	0,33	0,00	0,00	1,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
7	07.10.94	IVAN VALENCIA	20 DE JULIO		5,20	0,00	0,00	0,00	FRANCO ARENOSO	17,40	0,00	0,00	2,00	0,70	0,50	0,51	0,00	0,00	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
8	22.11.93	MARIA J. DAGUA	20 DE JULIO		5,30	0,00	0,00	0,00	ARENOSO FRANCO	15,20	0,00	0,00	6,00	3,00	1,30	0,60	0,00	0,00	1,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
9	26.11.68	PACIFICO GUETIA	20 DE JULIO	1830	5,20	0,00	0,00	0,00		8,48	0,00	0,00	3,20	2,94	0,00	0,18	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
10	01.06.90	ROBERTO ZAPE	20 DE JULIO		5,00	0,00	0,00	0,00	FRANCO ARENOSO	13,20	0,00	0,00	1,00	1,60	0,60	0,34	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
11	25.09.69	ROBERTO ZAPE	20 DE JULIO		5,00	0,00	0,00	0,00		5,60	0,00	0,00	4,40	0,00	0,00	0,09	0,00	0,00	2,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
12	04.10.77	JUAN COMETA	ANDA LUCIA		5,40	0,00	0,00	0,00		16,50	0,83	0,00	2,17	0,00	0,00	0,66	0,00	0,00	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
13	04.10.77	JUAN COMETA	ANDA LUCIA		5,50	0,00	0,00	0,00		10,94	0,55	0,00	2,38	0,00	0,00	0,64	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
14	10.12.92	EUCLIDES PENA	ANDALUCIA		4,80	77,24	17,48	5,28	ARENOSO FRANCO	18,66	0,70	15,46	6,74	1,10	0,64	0,36	0,00	22,20	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	38,9
15	07.12.92	JOSE RAMOS CAYAPU	ANDALUCIA		5,20	72,32	17,84	5,84	ARENOSO FRANCO	23,76	1,01	13,64	4,80	1,50	0,25	0,29	0,00	22,20	0,90	0,90	2,20	0,40	13,00	0,08	0,40	0,40	30,6
16	10.05.82	LORENZO GUETOTO	ANDALUCIA		4,90	57,60	22,56	19,84	FRANCO ARENOSO	7,15	0,25	16,60	1,83	0,57	0,26	0,14	0,50	15,20	2,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	67,0
17	15.06.77	SOCIOS INCORA - CLAUDIO SOLARTE	ANDALUCIA		5,80	0,00	0,00	0,00		18,32	0,91	11,60	2,38	4,14	1,50	0,51	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
18	15.06.77	SOCIOS INCORA - CLAUDIO SOLARTE	ANDALUCIA		5,80	0,00	0,00	0,00		18,00	0,90	11,60	0,77	0,42	0,39	0,29	0,00	0,00	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
19	15.11.82	LUIS ERAZO	BETANIA		5,40	77,60	18,56	3,84	ARENOSO FRANCO	10,40	0,67	9,00	0,18	0,35	0,10	0,24	0,54	19,80	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
20	16.06.93	ARU EZEQUIEL PATINO	BUENA VISTA		4,70	76,88	18,56	4,56	ARENOSO FRANCO	22,62	0,78	16,80	3,00	0,65	0,34	0,33	0,00	22,40	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	53,2
21	14.09.92	SAUL VILLALBA	BUENA VISTA		4,10	0,00	0,00	0,00	FRANCO ARENOSO	24,70	0,00	0,00	3,00	0,70	0,30	0,50	0,00	0,00	4,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
22	09.10.79	ARLEY VIDAL	CAMPO ALEGRE		5,90	0,00	0,00	0,00		15,56	0,78	11,60	4,00	2,11	0,89	0,84	0,00	0,00	0,00	4,60	3,60	0,00	0,00	0,02	0,40	0,40	0,0
23	22.11.93	AURELIANO MOSTACILLA	CAMPO ALEGRE	1808	4,80	0,00	0,00	0,00	FRANCO	8,60	0,00	0,00	3,00	0,80	0,40	0,27	0,00	0,00	3,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
24	22.11.93	FRANCISCO M. FERNANDEZ	CAMPO ALEGRE		4,50	0,00	0,00	0,00	FRANCO ARENOSO	8,70	0,00	0,00	5,00	0,90	0,30	0,23	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
25	22.11.93	GIOVANY MUNOZ	CAMPO ALEGRE		5,70	0,00	0,00	0,00	FRANCO ARENOSO	8,80	0,00	0,00	3,00	3,60	1,50	2,35	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
26	22.11.93	LUIS A. MOSQUERA	CAMPO ALEGRE	1562	4,90	0,00	0,00	0,00	ARENOSO FRANCO	8,60	0,00	0,00	4,00	1,40	0,50	0,36	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
27	25.02.92	MARINO VIDAL	CAM PO ALEGRE	1738	4,60	59,98	19,48	20,54	FRANCO ARCILLO ARENOSO	4,21	0,29	8,42	3,20	1,40	1,00	0,38	0,00	16,80	2,40	2,40	6,90	0,60	12,80	0,06	0,40	0,40	46,3
28	30.11.90	ROSALBA IPIA	CAMPO ALEGRE		4,10	0,00	0,00	0,00	FRANCO ARCILLO ARENOSO	12,10	0,00	0,00	3,00	0,50	0,20	0,38	0,00	0,00	3,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
29	30.11.90	ROSALBA IPIA	CAMPO ALEGRE		4,60	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	13,00	0,00	0,00	2,00	0,50	0,20	0,26	0,00	0,00	2,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
30	21.10.68	ABRAHAM ZAPE	CERRO ALTO	1740	5,30	0,00	0,00	0,00		14,40	0,00	0,00	3,30	1,68	0,00	0,19	0,00	0,00	2,95	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
31	23.10.90	ALFONSO TOVAR	CERRO ALTO		4,10	0,00	0,00	0,00	FRANCO ARENOSO	16,00	0,00	0,00	2,00	0,50	0,20	1,10	0,00	0,00	2,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
32	22.11.93	ANGELICA GUETOTO	CERRO ALTO		4,70	0,00	0,00	0,00	ARENOSO FRANCO	15,80	0,00	0,00	5,00	1,60	0,40	0,17	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
33	23.10.90	ANGELINA MEDINA	CERRO ALTO		3,90	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	6,90	0,00	0,00	2,00	0,80	0,40	0,53	0,00	0,00	3,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
34	15.02.91	ARNULFO HURTADO	CERRO ALTO		4,10	0,00	0,00	0,00	FRANCO ARENOSO	9,70	0,00	0,00	1,00	0,90	0,30	0,20	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
35	24.05.83	FABIO ORREGO	CERRO ALTO		5,00	32,88	24,56	42,56	ARCILLOSO	2,30	0,13	10,30	0,88	0,16	0,06	0,14	0,00	10,80	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	86,0
36	24.05.83	FABIO ORREGO	CERRO ALTO		4,20	46,88	28,56	24,56	FRANCO	7,50	0,31	14,00	1,40	0,11	0,04	0,19	0,00	18,40	3,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	92,0
37	15.11.82	GONZALO VARGAS	CERRO ALTO		5,00	73,60	20,56	5,84	FRANCO ARENOSO	16,00	0,67	13,90	2,10	0,83	0,17	0,24	0,59	25,80	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	55,0
38	21.06.90	GRISELDINO GUETIO	CERRO ALTO		4,40	0,00	0,00	0,00	FRANCO ARENOSO	8,70	0,00	0,00	1,00	0,90	0,40	0,29	0,00	0,00	1,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
39	04.11.69	HERIBERTO SANDOVAL	CERRO ALTO	1740	5,30	0,00	0,00	0,00	FRANCO	14,80	0,00	0,00	3,50	0,00	0,00	0,43	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
40	26.04.91	JOSE E. GUETIO	CERRO ALTO		4,10	0,00	0,00	0,00	FRANCO	8,10	0,00	0,00	1,00	0,80	0,50	0,29	0,00	0,00	2,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
41	29.05.90	LUIS G. RIVERA	CERRO ALTO		4,60	0,00	0,00	0,00	FRANCO ARCILLO ARENOSO	10,20	0,00	0,00	1,00	0,40	0,30	0,60	0,00	0,00	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
42	20.09.90	LUZ ANGELA TOBAR	CERRO ALTO		4,50	0,00	0,00	0,00	FRANCO ARENOSO	11,30	0,00	0,00	1,00	0,50	0,30	0,29	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
43	05.07.90	MARIA ANTONIA YOCUE	CERRO ALTO	1711	4,60	0,00	0,00	0,00	FRANCO ARENOSO	10,70	0,00	0,00	4,00	0,90	0,40	0,77	0,00	0,00	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
44	24.04.69	SIMEON MUNOZ	CERRO ALTO	1668	5,40	0,00	0,00	0,00		14,20	0,00	0,00	1,50	0,00	0,00	0,24	0,00	0,00	0,55	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
45	15.12.76	IVAN SANDOVAL	CHINDACO		5,20	0,00	0,00	0,00		10,30	0,51	0,00	1,92	0,00	0,00	0,26	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
46	21.06.90	GERARDO G. TRUJILLO	CRUC. PESCADOR		4,60	0,00	0,00	0,00	FRANCO ARENOSO	11,00	0,00	0,00	1,00	0,80	0,20	0,40	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
47	26.06.90	GERARDO G. TRUJILLO	CRUC. PESCADOR		5,10	0,00	0,00	0,00	FRANCO ARENOSO	8,90	0,00	0,00	1,00	0,90	0,30	0,54	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
48	26.06.90	GERARDO GUIDO TRUJILLO	CRUC. PESCADOR		5,50	0,00	0,00	0,00	FRANCO ARENOSO	8,10	0,00	0,00	9,00	2,10	0,40	1,62	0,00	0,00	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0

49	09.04.91	HERMES VITELIO MUZA	CRUC. PESCADOR		4,30	66,88	21,84	11,28	FRANCO ARENOSO	7,30	0,31	13,60	6,00	0,60	0,27	0,26	0,00	10,80	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	49,9
50	04.11.94	DEYANIRA ALMENDRA	CRUC. ROSARIO		6,10	0,00	0,00	0,00	FRANCO ARCILLO ARENOSO	13,60	0,00	0,00	69,00	9,10	5,10	1,36	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
51	20.06.90	FREDY ALBERTO PAZ	CRUC. ROSARIO		4,20	54,16	21,84	24,00	FRANCO ARCLLO ARENOSO	9,70	0,34	16,50	3,06	0,46	0,17	0,47	0,00	19,80	3,90	1,00	4,70	0,50	8,70	0,10	0,40	0,40	78,0
52	22.11.93	EDWIN VALENCIA	DARIEN		7,60	0,00	0,00	0,00	FRANCO ARENOSO	6,80	0,00	0,00	101,00	8,80	1,60	1,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
53	24.08.77	PATRICIO CAMPO	DARIEN	1744	4,80	0,00	0,00	0,00		17,70	0,89	0,00	1,96	0,00	0,00	0,30	0,00	0,00	4,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
54	19.12.94	ANA MARCELY PALTA	EL ALIZAL		5,40	0,00	0,00	0,00	FRANCO ARCILLO ARENOSO	5,90	0,00	0,00	7,00	5,60	2,00	0,36	0,00	0,00	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
55	28.09.78	ANASTACIO CASTRO S.	EL CABUYAL		4,90	0,00	0,00	0,00		5,42	0,27	0,00	1,61	0,00	0,00	0,37	0,00	0,00	2,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
56	22.11.93	JORGE R. SANCHEZ	EL CABUYAL		4,30	0,00	0,00	0,00	FRANCO ARENOSO	6,80	0,00	0,00	5,00	0,70	0,30	0,15	0,00	0,00	4,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
57	30.11.90	JORGE SANCHEZ	EL CABUYAL		4,20	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	8,80	0,00	0,00	1,00	0,30	0,20	0,29	0,00	0,00	2,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
58	19.12.94	LUIS A. CALAMBAS	EL CAIRITO		5,10	0,00	0,00	0,00	FRANCO ARENOSO	0,00	0,00	0,00	2,00	1,30	0,20	0,31	0,00	0,00	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
59	21.07.80	LIGIA VALKIE	EL CASCABEL		4,50	32,88	31,28	35,84	FRANCO ARCILLOSO	0,37	0,20	1,10	1,93	0,68	0,52	0,66	0,37	17,60	9,50	3,00	153,20	3,10	48,80	0,18	0,70	2,00	84,0
60	21.07.80	LIGIA VALKIE	EL CASCABEL		4,60	42,88	31,20	25,84	FRANCO	1,15	0,10	6,70	0,96	0,30	0,17	0,62	0,33	18,80	6,80	1,10	107,20	2,10	20,20	0,09	0,40	0,40	86,0
61	21.07.80	LIGIA VALKIE	EL CASCABEL		4,90	28,88	33,28	37,84	FRANCO ARCILLOSO	0,37	0,08	2,70	0,88	0,16	0,38	0,66	0,39	18,80	8,90	5,40	12,00	3,10	21,20	0,30	0,70	2,00	88,0
62	21.07.80	LIGIA VALKIE	EL CASCABEL		4,30	36,88	33,28	29,84	FRANCO ARCILLOSO	1,20	0,25	2,80	1,49	0,50	0,33	0,74	0,39	14,40	7,50	3,00	51,60	0,90	16,50	0,06	0,30	2,00	83,0
63	21.07.80	LIGIA VALKIE	EL CASCABEL		4,50	34,88	23,28	41,84	ARCILLOSO	0,74	0,13	3,30	1,05	0,25	0,10	0,60	0,00	11,40	4,60	3,20	6,00	1,03	4,00	0,26	0,70	0,80	83,1
64	22.07.80	LIGIA VALKIE	EL CASCABEL		4,40	0,00	0,00	0,00		2,56	0,27	0,00	1,84	1,10	0,67	0,68	0,00	0,00	7,70	0,00	0,00	0,00	0,00	0,03	0,00	0,00	76,0
65	08.08.91	JAIME VILLANI TOVAR	EL CENTRO		5,40	74,32	19,84	5,84	FRANCO ARENOSO	17,50	0,80	12,70	12,80	8,50	1,70	0,61	0,00	21,60	0,20	4,90	5,20	0,90	10,40	0,30	0,00	0,00	0,0
66	04.02.94	JESUS MARIA GONZALEZ	EL CENTRO		4,70	0,00	0,00	0,00	FRANCO ARCILLO ARENOSO	6,40	0,00	0,00	3,00	1,20	1,00	0,46	0,00	0,00	1,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
67	22.11.93	LUIS A. CUCHILLA	EL CENTRO		4,60	0,00	0,00	0,00	FRANCO	7,80	0,00	0,00	3,00	1,20	0,40	0,18	0,00	0,00	3,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
68	10.11.76	ARIOSTO RENGIFO	EL CIDRAL		5,10	0,00	0,00	0,00		14,28	0,71	0,00	1,96	0,00	0,00	0,36	0,00	0,00	3,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
69	06.08.90	DIOMEDES ROSERO	EL CIDRAL		4,40	0,00	0,00	0,00	FRANCO ARENOSO	11,50	0,00	0,00	2,00	0,40	0,20	0,26	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
70	06.08.90	DIOMEDES ROSERO	EL CIDRAL		4,70	0,00	0,00	0,00	FRANCO ARENOSO	17,20	0,00	0,00	6,00	0,70	0,30	0,54	0,00	0,00	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
71	10.02.87	JOSE CORDOBA	EL CIDRAL		6,10	0,00	0,00	0,00		13,00	0,65	0,00	25,70	0,00	0,00	0,25	0,00	22,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
72	30.11.90	LUIS PANTOJA	EL CIDRAL		4,80	0,00	0,00	0,00	FRANCO ARENOSO	12,50	0,00	0,00	14,00	1,50	0,30	0,85	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
73	16.07.91	RICAR DO SOTO	EL CIDRAL		4,60	0,00	0,00	0,00	FRANCO ARENOSO	11,20	0,00	0,00	1,00	1,60	0,80	0,26	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
74	26.07.91	RICARDO SOTO	EL CIDRAL		4,70	0,00	0,00	0,00	FRANCO ARCILLO ARENOSO	8,50	0,00	0,00	1,00	5,70	2,50	0,26	0,00	0,00	0,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
75	10.02.87	SILVIO MERA	EL CIDRAL		4,80	0,00	0,00	0,00		5,30	0,29	0,00	6,20	0,00	0,00	0,37	0,00	0,00	2,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
76	10.02.87	SILVIO MERA	EL CIDRAL		5,20	0,00	0,00	0,00		4,50	0,23	0,00	5,00	0,00	0,00	0,70	15,60	0,00	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
77	01.06.90	SILVIO MERA	EL CIDRAL		4,70	0,00	0,00	0,00	FRANCO ARENOSO	9,80	0,00	0,00	1,00	0,60	0,20	0,45	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
78	30.09.93	RODRIGO CEBALLOS	EL GUAICO ALIZAL		5,20	69,24	24,20	6,56	FRANCO ARENOSO	17,48	0,73	13,90	3,90	14,00	4,50	0,84	0,00	22,20	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	6,3
79	16.06.93	JOSE ANTONIO TOMBE	EL GUAICO ARENAL		5,70	52,88	34,56	12,56	FRANCO ARENOSO	5,60	0,36	9,00	77,00	7,60	2,60	0,37	0,00	21,80	0,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,9
80	04.11.94	JOSE ANTONIO TOMBE	EL GUAICO ARENAL		6,20	0,00	0,00	0,00	FRANCO ARCILLO ARENOSO	4,70	0,00	0,00	53,00	6,30	2,60	0,49	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
81	10.11.93	LINO BOMBA	EL NARCIZO		5,20	75,80	17,64	6,56	FRANCO ARENOSO	12,36	0,29	24,70	3,20	1,40	0,83	0,26	0,00	18,20	2,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	51,1
82	11.07.90	FABIO DANQUI	EL PICACHO		4,80	0,00	0,00	0,00	FRANCO ARENOSO	23,40	0,00	0,00	3,00	0,60	0,10	0,29	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
83	05.07.90	JESUS M. MUELAS	EL PICACHO		5,00	0,00	0,00	0,00	FRANCO ARENOSO	17,50	0,00	0,00	1,00	0,40	0,30	0,18	0,00	0,00	0,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
84	31.10.88	FABIO POLANIA	EL PITAL		4,30	46,50	28,38	25,12	FRANCO	4,80	0,29	9,60	3,15	0,41	0,15	0,29	0,00	15,20	3,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	80,0
85	31.10.88	FABIO POLANIA	EL PITAL		4,20	48,50	26,38	25,12	FRANCO	4,70	0,25	10,90	3,15	0,41	0,23	0,26	0,00	16,20	3,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	79,1
86	31.10.88	FABIO POLANIA	EL PITAL		4,20	48,50	26,38	25,12	FRANCO	4,70	0,25	10,90	3,15	0,41	0,23	0,26	0,00	16,20	3,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	79,1
87	06.12.76	JOSE SARRIA	EL PITAL		4,70	0,00	0,00	0,00		2,18	0,11	0,00	0,35	0,00	0,00	0,13	0,00	0,00	2,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
88	06.12.76	JOSE SARRIA	EL PITAL		4,10	0,00	0,00	0,00		5,48	0,27	0,00	2,27	0,00	0,00	0,16	0,00	0,00	3,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
89	07.07.77	LUIS ANGEL MOSQUERA	EL PITAL		5,20	41,30	24,55	34,15	FRANCO ARCILLOSO	4,54	0,23	0,00	1,54	1,00	0,42	0,15	0,10	18,80	3,00	3,32	31,80	1,84	0,00	0,04	1,28	2,40	0,0
90	07.07.77	LUIS ANGEL MOSQUERA	EL PITAL		5,20	38,80	29,55	31,65	FRANCO ARCILLOSO	5,64	0,28	0,00	2,00	0,63	0,41	0,18	0,10	19,80	2,70	2,64	14,20	1,04	0,00	0,06	0,80	1,40	0,0
91	07.07.77	LUIS ANGEL MOSQUERA	EL PITAL		4,70	33,80	32,05	34,15	FRANCO ARCILLOSO	5,46	0,27	0,00	2,73	0,80	0,50	0,23	0,20	18,40	2,80	2,80	33,70	1,60	0,00	0,09	1,28	3,40	0,0
92	07.07.77	LUIS ANGEL MOSQUERA	EL PITAL		4,80	48,80	27,05	24,15	ARCILLO ARENOSO	5,56	0,28	0,00	3,33	0,59	0,53	0,35	0,20	22,00	3,10	4,04	19,40	1,04	0,00	0,13	1,80	2,40	0,0
93	07.07.77	LUIS ANGEL MOSQUERA	EL PITAL		0,00	0,00	0,00	0,00		12,72	0,64	0,00	207,79	14,78	9,13	19,84	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
94	23.10.90	MANUEL J. HERNAN	EL PITAL		3,70	0,00	0,00	0,00	FRANCO ARCILLOSO	5,40	0,00	0,00	2,00	0,60	0,20	0,45	0,00	0,00	3,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
95	18.06.93	VICTOR RIOS	EL PITAL		4,50	52,88	28,56	18,56	ARENOSO FRANCO	6,54	0,20	19,00	3,40	0,32	0,13	0,20	0,00	16,80	1,90	1,60	3,10	0,60	10,50	0,15	0,40	0,40	74,5
96	20.09.90	ARNULFO CAMPO	EL PORVENIR		4,50	0,00	0,00	0,00	FRANCO ARENOSO	22,40	0,00	0,00	1,00	0,50	0,30	0,54	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
97	08.11.93	EDILBERTO ACHINTE	EL PORVENIR		4,70	50,88	28,74	20,38	FRANCO	5,77	0,31	10,80	3,90	1,10	0,37	0,34	0,00	14,00	1,90	3,30	5,30	0,50	9,60	0,10	0,40	0,40	51,2
98	09.03.92	JOSE ANTONIO BOMBO	EL PORVENIR		5,40	0,00	0,00	0,00	ARENOSO	14,00	0,00	0,00	2,00	1,00	0,50	0,20	0,00	0,00	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
99	30.08.94	JOSE CRUZ BOMBA	EL PORVENIR		5,10	0,00	0,00	0,00	FRANCO ARENOSO	20,00	0,00	0,00	2,00	3,60	1,20	0,38	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
100	22.11.93	JOSE ANTONIO PIAMBA	EL PORVENIR VILACHI		5,30	0,00	0,00	0,00	FRANCO ARENOSO	15,90	0,00	0,00	3,00	2,00	0,70	0,35	0,00	0,00	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
101	27.11.90	VENANCIO MEDINA	EL PORVENIR VILACHI		4,50	0,00	0,00	0,00	FRANCO ARENOSO	14,80	0,00	0,00	2,00	1,00	0,30	0,40	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
102	02.08.83	LUCINDO YOTENGO	EL RINCON		5,10	75,60	21,20	3,20	ARENOSO FRANCO	9,90	0,31	18,50	2,60	1,40	0,52	0,60	0,00	19,80	0,80	2,10	6,40	1,20	23,50	0,21	0,40	0,40	24,0

103	05.07.90	BENJAMIN ZUNIGA	EL ROSAL		4,40	0,00	0,00	0,00	ARCILLOSO	5,20	0,00	0,00	2,00	0,60	0,40	0,26	0,00	0,00	2,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
104	08.07.86	GRUPO DE SOCIOS EL ROSAL	EL ROSAL		5,40	69,04	21,84	9,12	FRANCO ARENOSO	3,94	0,24	9,50	1,10	2,00	1,10	0,14	0,00	13,20	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	13,4
105	14.04.94	NESTOR ALZATE	EL ROSAL		5,60	49,24	33,64	17,12	FRANCO	1,86	0,14	7,70	115,50	2,80	2,40	1,74	0,00	13,20	0,10	4,80	9,50	1,30	25,50	0,12	0,40	0,40	0,0
106	02.08.83	RAFAEL FERNANDEZ	EL ROSARIO		5,70	73,60	23,20	3,20	ARENOSO FRANCO	18,80	0,67	16,30	3,40	1,40	0,35	0,47	0,83	22,00	0,50	1,40	4,00	1,00	5,60	0,40	0,40	1,00	18,0
107	20.09.90	NOE PRIETO	EL TABLON		4,30	0,00	0,00	0,00	FRANCO ARCILLOSO	5,60	0,00	0,00	2,00	1,60	0,70	0,45	0,00	0,00	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
108	20.09.90	NOE PRIETO	EL TABLON		4,50	0,00	0,00	0,00	FRANCO ARCILLOSO	6,30	0,00	0,00	3,00	1,70	0,80	0,37	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
109	11.07.90	OTONIEL VELAZCO	EL TABLON	1495	5,00	0,00	0,00	0,00	FRANCO ARCILLOSO	5,20	0,00	0,00	4,00	2,70	0,80	0,34	0,00	0,00	0,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
110	20.05.92	ANTONIO ULCUE	EL TARSO		5,50	53,96	30,20	15,84	FRANCO ARENOSO	7,50	0,27	16,11	1,80	8,90	4,35	0,25	0,00	21,40	0,30	0,80	3,80	0,60	1,50	0,08	0,40	0,40	3,1
111	08.04.92	DOMINGO CHICANE	EL TARSO-P. ZUNIGA		5,20	74,32	16,76	8,92	FRANCO ARENOSO	16,12	0,46	20,33	2,50	1,20	0,75	0,15	0,00	27,20	2,40	1,80	8,70	0,60	4,00	0,06	0,40	0,40	53,3
112	07.09.77	OSCAR MENZA	GRANADILLO		5,95	0,00	0,00	0,00		14,84	0,74	0,00	2,31	0,00	0,00	0,68	0,00	0,00	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
113	22.11.93	FELIPE MENZA	GUALO		5,20	0,00	0,00	0,00	FRANCO ARENOSO	18,80	0,00	0,00	8,00	4,50	3,10	1,30	0,00	0,00	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
114	03.12.93	GUILLERMO CHOCUE	GUALO		5,30	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	8,50	0,00	0,00	4,00	4,90	3,80	0,43	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
115	22.11.93	JULIO D. CAYAPU	GUALO		5,20	0,00	0,00	0,00	FRANCO ARCILLOSO	7,60	0,00	0,00	7,00	3,50	1,00	0,18	0,00	0,00	2,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
116	06.08.90	MIGUEL A. TROCHEZ	LA BUITRERA	1746	4,50	0,00	0,00	0,00	FRANCO ARENOSO	17,80	0,00	0,00	1,00	0,40	0,30	0,45	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
117	01.06.90	RECUEL TORRES	LA BUITRERA		4,80	0,00	0,00	0,00	FRANCO ARENOSO	17,30	0,00	0,00	1,00	0,40	0,20	0,82	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
118	08.10.93	JORGE E. SANCHEZ	LA CAMPINA		5,20	65,62	27,46	6,92	FRANCO ARENOSO	7,53	0,42	10,40	3,20	1,60	0,35	0,51	0,50	15,40	0,40	2,90	3,10	0,50	8,00	0,08	0,40	0,40	0,0
119	14.05.82	CESAR ARIAS	LA CAMPIÑA		4,80	37,60	22,56	39,84	FRANCO ARCILLOSO	5,00	0,15	19,80	2,10	1,07	0,56	0,14	0,52	13,40	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	66,0
120	01.06.90	LUIS GERARDO LEON	LA ESPERANZA	1978	4,80	0,00	0,00	0,00	ARENOSO FRANCO	15,60	0,00	0,00	2,00	0,40	0,20	0,36	0,00	0,00	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
121	19.05.92	FREDY ENRIQUE MOSQUERA	LA ESTRELLA		5,10	67,96	18,20	13,84	FRANCO ARENOSO	9,66	0,29	19,32	10,50	1,30	0,29	0,29	0,00	30,40	1,20	1,30	3,10	1,00	3,20	0,06	0,40	0,40	39,0
122	19.05.92	FREDY ENRIQUE MOSQUERA	LA ESTRELLA		4,90	61,96	18,20	19,84	FRANCO ARENOSO	10,16	0,18	32,74	3,20	1,00	0,29	0,27	0,00	22,80	2,00	1,10	4,00	1,00	2,40	0,06	0,40	0,40	56,2
123	19.05.92	FREDY ENRIQUE MOSQUERA	LA ESTRELLA		5,40	73,96	18,20	7,84	FRANCO ARENOSO	10,38	0,42	14,33	2,70	1,10	0,25	0,30	0,00	27,60	0,50	1,50	3,10	0,60	1,50	0,13	0,40	0,40	23,3
124	22.11.93	MIGUEL S. VELASCO	LA ESTRELLA	1717	4,70	0,00	0,00	0,00	FRANCO ARENOSO	10,70	0,00	0,00	4,00	2,00	0,70	0,55	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
125	06.12.76	ARTURO RENGIFO	LA LAGUNA		4,90	0,00	0,00	0,00		12,94	0,65	0,00	1,92	0,00	0,00	0,40	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
126	12.12.90	LUIS CARLOS PAZ	LA LAGUNA		4,10	53,60	24,56	21,84	FRANCO ARCILLOARENOSO	8,30	0,81	5,90	6,70	0,70	0,22	0,36	0,00	14,00	4,20	4,00	5,40	1,00	15,20	0,08	0,40	0,40	77,0
127	12.12.90	LUIS CARLOS PAZ	LA LAGUNA		5,30	55,60	22,56	21,84	FRANCO ARENOSO	6,70	0,61	6,40	9,70	2,80	0,43	0,89	0,00	13,60	0,50	5,10	6,40	0,80	20,00	0,06	0,40	0,40	0,0
128	12.12.90	LUIS CARLOS PAZ	LA LAGUNA		4,30	51,60	16,56	21,84	FRANCO ARENOSO	7,20	0,72	5,80	1,90	0,70	0,29	0,44	0,00	13,80	3,00	5,60	6,90	1,00	12,80	0,08	0,40	0,40	68,0
129	20.09.90	JOSE DOMINGO PIAMBA	LA LANADA		4,20	0,00	0,00	0,00	ARCILLO LIMOSO	5,50	0,00	0,00	1,00	1,10	0,40	0,34	0,00	0,00	2,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
130	06.08.90	EVANGELISTA RIVERA	LA LLANADA		4,30	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	15,50	0,00	0,00	1,00	0,70	0,40	0,24	0,00	0,00	4,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
131	19.12.94	LUIS ANGEL PAZ	LA LLANADA		4,40	0,00	0,00	0,00	ARCILLOSO LIMOSO	5,60	0,00	0,00	3,00	1,90	0,70	0,30	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
132	03.08.94	HOMAR HURTADO PAZ	LA PALOMERA		5,40	0,00	0,00	0,00	FRANCO ARCLLOARENOSO	6,00	0,00	0,00	2,00	5,30	4,50	0,61	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
133	13.05.87	MAUREL ANTONIO MUNOZ	LA VEGA		5,00	0,00	0,00	0,00		16,10	0,74	12,60	4,30	0,84	0,35	0,39	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,03	0,00	0,00	58,2
134	07.10.92	MARIA ANTONIO ALMENDRA	LA VENTA		8,20	68,14	23,12	8,74	FRANCO ARENOSO	9,68	0,60	9,36	2,20	1,10	0,29	0,29	0,00	24,40	0,00	1,00	3,60	0,40	9,60	0,06	0,40	0,40	0,0
135	22.11.93	MARIA G. ALMENDRA	LA VENTA		4,60	0,00	0,00	0,00	FRANCO ARENOSO	7,70	0,00	0,00	21,00	1,80	0,50	0,75	0,00	0,00	2,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
136	16.06.93	MICAELA ALMENDRA	LA VENTA	1760	4,20	46,88	22,56	30,56	FRANCO ARCILLOARENOSO	9,12	0,38	13,90	5,90	0,68	0,38	0,31	0,00	20,00	4,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	74,5
137	04.07.90	OLIVERIO TROCHEZ	LA VENTANA		5,00	69,08	24,56	6,36	FRANCO ARENOSO	16,20	0,43	21,80	3,06	0,58	0,13	0,40	0,00	21,00	0,50	1,40	4,80	0,40	4,80	0,05	0,40	0,40	31,0
138	30.04.90	BALTAZAR FERNANDEZ	LAS DELICIAS		4,50	0,00	0,00	0,00	FRANCO ARENOSO	20,40	0,00	0,00	5,00	1,30	0,40	0,46	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
139	21.06.90	CARMEN MENE	LAS DELICIAS		4,70	0,00	0,00	0,00	FRANCO ARENOSO	15,40	0,00	0,00	1,00	0,50	0,10	0,40	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,0	0,00	0,00	0,0
140	08.05.90	ERNESTO BECOCHE	LAS DELICIAS		4,70	0,00	0,00	0,00	ARCILLO LIMOSO	5,80	0,00	0,00	5,00	1,20	0,60	0,46	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
141	21.06.90	ERNESTO BECOCHE	LAS DELICIAS		4,60	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	3,50	0,00	0,00	1,00	0,80	0,40	0,34	0,00	0,00	3,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
142	16.06.93	FRANCISCO BECOCHE	LAS DELICIAS		4,80	38,88	28,56	32,56	FRANCO ARCILLOSO	6,00	0,38	9,10	4,80	3,00	0,60	0,47	0,00	16,80	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	25,6
143	11.07.90	GABRIEL MACA	LAS DELICIAS		4,20	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	6,30	0,00	0,00	3,00	0,70	0,20	0,29	0,00	0,00	3,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
144	30.04.90	GONZALO LIS	LAS DELICIAS		4,30	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	4,30	0,00	0,00	4,00	1,00	0,50	0,41	0,00	0,00	2,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
145	21.06.90	ISAIAS PENA	LAS DELICIAS		4,80	0,00	0,00	0,00	FRANCO ARCILLOLIMOSO	7,50	0,00	0,00	13,00	1,30	0,50	0,18	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
146	23.10.90	JOSE S. MEDINA	LAS DELICIAS		4,30	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	4,60	0,00	0,00	5,00	2,20	0,80	1,10	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
147	21.06.90	JOSE SANTOS MEDINA	LAS DELICIAS		4,60	0,00	0,00	0,00	FRANCO ARENOSO	19,60	0,00	0,00	1,00	0,50	0,20	0,34	0,00	0,00	1,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
148	03.12.93	JOSE SANTOS MEDINA	LAS DELICIAS		4,70	0,00	0,00	0,00	FRANCO ARENOSO	19,20	0,00	0,00	2,00	1,00	0,40	0,65	0,00	0,00	1,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
149	23.07.90	JOSE SANTOS NENE	LAS DELICIAS		4,20	0,00	0,00	0,00	FRANCO ARENOSO	24,10	0,00	0,00	1,00	0,40	0,20	0,37	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
150	30.07.91	JULIO GUETIO	LAS DELICIAS		4,60	0,00	0,00	0,00	FRANCO ARENOSO	13,40	0,00	0,00	2,00	2,50	0,80	0,46	0,00	0,00	1,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
151	18.11.94	MARCELINO ULCUE	LAS DELICIAS		5,00	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	6,00	0,00	0,00	3,00	1,50	0,70	0,24	0,00	0,00	3,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
152	18.02.94	ROBERTO ELAGO	LAS DELICIAS		4,60	0,00	0,00	0,00	FRANCO ARENOSO	13,50	0,00	0,00	4,00	0,60	0,20	0,20	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
153	09.03.90	ANTONIO ROMERO	LAS MERCEDES		4,70	0,00	0,00	0,00	FRANCO ARCILLOSO	3,80	0,00	0,00	1,00	0,50	0,10	0,28	0,00	0,00	3,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
154	27.11.90	ANTONIO ROMERO	LAS MERCEDES		4,10	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	8,40	0,00	0,00	2,00	0,50	0,20	0,20	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
155	27.11.90	ANTONIO ROMERO	LAS MERCEDES		4,10	0,00	0,00	0,00	FRANCO ARCILLOSO	6,80	0,00	0,00	2,00	0,60	0,20	0,22	0,00	0,00	2,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
156	25.01.93	ANTONIO ROMERO	LAS MERCEDES		4,40	0,00	0,00	0,00	FRANCO	5,50	0,43	6,90	3,50	1,20	0,44	0,34	0,00	16,40	2,40	1,00	10,10	0,50	20,00	0,20	0,40	0,40	56,0

157	25.01.93	ANTONIO ROMERO	LAS MERCEDES		4,40	0,00	0,00	0,00	FRANCO	4,10	0,35	6,90	3,20	1,30	0,42	0,22	0,00	12,40	2,80	1,20	12,00	0,80	21,80	0,15	0,40	0,40	59,0
158	25.01.93	ANTONIO ROMERO	LAS MERCEDES		4,20	0,00	0,00	0,00	FRANCO	5,30	0,39	7,90	2,40	0,85	0,33	0,29	0,00	15,40	3,80	1,10	7,10	0,90	8,00	0,20	0,40	0,40	72,0
159	17.06.93	ANTONIO ROMERO	LAS MERCEDES		4,50	42,88	40,56	16,56	FRANCO	6,80	0,39	10,10	1,60	0,49	0,28	0,26	0,00	15,00	3,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	78,2
160	09.03.90	ANTONIO ROMERO (FEDERACION)	LAS MERCEDES		4,90	0,00	0,00	0,00	FRANCO ARCILLOSO	3,40	0,00	0,00	1,00	0,30	0,10	0,24	0,00	0,00	2,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
161	22.08.90	ANTONIO ROMERO R.	LAS MERCEDES		3,90	57,24	10,20	32,56	FRANCOARCILLOARENOSO	6,60	0,29	13,20	2,90	0,36	0,25	0,51	0,00	13,20	3,50	1,50	10,40	0,60	10,50	0,07	0,40	0,40	75,0
162	21.06.90	ARCADIO YONDA P.	LAS MERCEDES		4,40	0,00	0,00	0,00	FRANCO ARCILLOSO	8,70	0,00	0,00	1,00	0,70	0,30	0,29	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
163	30.07.90	ARNULFO OTERO	LAS MERCEDES	1652	4,10	0,00	0,00	0,00	FRANCO ARCILLOSO	5,70	0,00	0,00	1,00	0,70	0,30	0,26	0,00	0,00	3,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
164	06.08.90	EZEQUIEL OTERO	LAS MERCEDES		4,30	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	13,30	0,00	0,00	1,00	0,50	0,30	0,29	0,00	0,00	2,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
165	04.02.94	EZEQUIEL OTERO	LAS MERCEDES		5,00	0,00	0,00	0,00	FRANCO ARCILLOSO	7,00	0,00	0,00	3,00	2,50	1,90	0,28	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
166	04.02.94	EZEQUIEL OTERO	LAS MERCEDES		4,50	0,00	0,00	0,00	FRANCOARENOSO	4,40	0,00	0,00	2,00	0,90	0,70	0,40	0,00	0,00	2,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
167	11.07.90	JOSE ALDEMAR VARGAS	LAS MERCEDES		4,40	0,00	0,00	0,00	FRANCOARENOSO	9,20	0,00	0,00	4,00	0,90	0,20	0,34	0,00	0,00	2,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
168	27.09.91	LUIS G. RIVERA	LAS MERCEDES		4,40	0,00	0,00	0,00	FRANCOARCILLOARENOSO	8,80	0,00	0,00	2,00	1,40	0,80	0,46	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
169	27.09.91	LUIS G. RIVERA	LAS MERCEDES		4,10	0,00	0,00	0,00	FRANCOARCILLOARENOSO	8,50	0,00	0,00	2,00	1,20	0,50	0,29	0,00	0,00	3,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
170	27.09.91	LUIS G. RIVERA	LAS MERCEDES		4,80	0,00	0,00	0,00	FRANCOARENOSO	12,00	0,00	0,00	6,00	1,00	1,10	0,50	0,00	0,00	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
171	25.01.93	NTONIO ROMER O	LAS MERCEDES		4,50	0,00	0,00	0,00	FRANCO	3,50	0,31	6,50	3,90	0,75	0,33	0,34	0,00	16,00	3,00	1,30	3,10	0,50	17,00	0,15	0,40	0,40	68,0
172	30.04.90	ROBERTO OTERO	LAS MERCEDES	1700	4,50	0,00	0,00	0,00	FRANCOARENOSO	20,40	0,00	0,00	5,00	1,30	0,40	0,46	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
173	23.07.90	SIMEON RIOS	LAS MERCEDES		3,80	0,00	0,00	0,00	ARCILLOSO	5,40	0,00	0,00	2,00	0,60	0,30	0,35	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
174	06.07.90	AURA MARIA PATINO	LOS QUINGOS		4,30	0,00	0,00	0,00	FRANCOARCILLOARENOSO	9,00	0,00	0,00	1,00	0,40	0,20	0,18	0,00	0,00	3,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
175	06.07.90	FERNANDO RENJIFO	LOS QUINGOS	1718	4,70	0,00	0,00	0,00	FRANCOARCILLOARENOSO	20,40	0,00	0,00	1,00	0,80	0,40	0,45	0,00	0,00	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
176	06.07.90	FERNANDO RENJIFO	LOS QUINGOS		4,60	0,00	0,00	0,00	FRANCOARCILLOARENOSO	8,40	0,00	0,00	1,00	1,00	0,50	0,26	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
177	06.07.90	RODELFI BETANCOURT	LOS QUINGOS	1750	4,50	0,00	0,00	0,00	FRANCO ARCILLOSO	7,90	0,00	0,00	1,00	0,30	0,20	0,26	0,00	0,00	4,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
178	06.07.90	RODELFI BETANCOURT	LOS QUINGOS		4,10	0,00	0,00	0,00	FRANCOARENOSO	11,90	0,00	0,00	2,00	0,30	0,10	0,18	0,00	0,00	3,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
179	23.07.90	SIMEON RIOS	LOS QUINGOS	1703	4,60	0,00	0,00	0,00	FRANCOARENOSO	12,30	0,00	0,00	1,00	1,00	0,40	0,96	0,00	0,00	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
180	07.12.92	RAFAEL DAGUA	MIRAVALLE		4,10	53,24	27,48	19,28	FRANCOARENOSO	8,08	0,35	13,39	4,64	0,74	0,33	0,32	0,00	19,40	3,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	73,2
181	04.02.94	ZOILO PITO	MONTERILA	1629	4,30	0,00	0,00	0,00	FRANCOARENOSO	3,10	0,00	0,00	3,00	0,50	0,20	0,19	0,00	0,00	2,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
182	18.11.94	ANA OLIVA DIAZ	MONTERILLA		5,30	0,00	0,00	0,00	FRANCOARCILLOARENOSO	9,40	0,00	0,00	3,00	4,40	1,30	0,25	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
183	16.06.93	ANTONIO IBARRA	MONTERILLA		7,20	86,88	6,56	6,56	ARENOSO FRANCO	4,40	0,21	12,10	182,00	10,80	2,70	0,62	0,50	19,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
184	30.07.90	CARLOS RAMIRO BUENDIA	MONTERILLA		3,90	0,00	0,00	0,00	FRANCOARCILLOARENOSO	6,30	0,00	0,00	1,00	0,50	0,20	0,29	0,00	0,00	3,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
185	22.09.93	CELIMO USSA	MONTERILLA	1548	4,40	0,00	0,00	0,00	FRANCO ARCILLOSO	5,90	0,00	0,00	2,00	1,10	0,60	0,26	0,00	0,00	2,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
186	04.02.94	CELSO VIDAL	MONTERILLA	1582	4,20	0,00	0,00	0,00	FRANCO ARCILLOSO	4,30	0,00	0,00	3,00	0,70	0,40	0,29	0,00	0,00	3,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
188	30.07.91	EDUARDO RENDON	MONTERILLA		4,20	0,00	0,00	0,00	FRANCO ARCILLOSO	8,20	0,00	0,00	2,00	2,10	1,10	0,48	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
187	30.07.91	EDUARDO RENDON	MONTERILLA		5,60	0,00	0,00	0,00	FRANCO ARCILLOSO	7,70	0,00	0,00	39,00	7,20	1,00	0,36	0,00	0,00	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
189	08.01.70	GREGORIA ALAS	MONTERILLA	1468	4,80	0,00	0,00	0,00	ARENOSO ARCILLOSO	8,37	0,00	0,00	3,00	0,00	0,00	0,40	0,00	0,00	3,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
190	21.06.90	HUGO MUNOZ	MONTERILLA		4,20	0,00	0,00	0,00	ARCILLOSO	6,40	0,00	0,00	1,00	0,80	0,30	0,18	0,00	0,00	3,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
191	10.11.93	JORGE MORA	MONTERILLA	1410	4,60	29,80	33,64	36,56	FRANCO ARCILLOSO	4,52	0,20	13,10	2,50	1,00	0,33	0,38	0,00	13,40	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	56,3
192	30.09.93	JOSE ARBEY VIDAL	MONTERILLA		4,50	23,24	28,20	48,56	ARCILLOSO	4,29	0,17	14,60	3,50	0,60	0,50	0,17	0,00	11,60	3,00	2,00	10,30	0,90	23,20	0,07	0,40	0,40	70,2
193	30.04.90	LUIS GENTIL USSA	MONTERILLA		4,00	0,00	0,00	0,00	ARCILLO LIMOSO	5,00	0,00	0,00	4,00	0,80	0,30	0,41	0,00	0,00	2,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
194	15.11.88	RAMIRO BUENDIA	MONTERILLA		4,00	50,32	24,56	25,13	FRANCOARENOARCILLOSO	6,10	0,28	12,60	5,20	0,28	0,10	0,20	0,00	15,20	5,20	1,20	14,00	0,80	3,10	0,02	0,40	0,40	90,0
195	23.10.90	JOSEFINA PANCE	MONTERILLO	1614	4,50	0,00	0,00	0,00	FRANCO LIMOSO	5,60	0,00	0,00	4,00	1,00	0,40	0,53	0,00	0,00	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
196	10.05.82	FLOWER LEMOS	PALERMO		4,70	32,88	29,12	38,00	FRANCO ARCILLOSO	4,60	0,13	20,50	2,71	1,03	0,27	0,17	0,54	14,20	2,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	63,0
197	30.11.90	ANA ROSA MOLINA	PANAMERICANA		4,40	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	11,80	0,00	0,00	2,00	0,40	0,20	0,20	0,00	0,00	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
198	29.08.88	CESAR PIEDRAH ITA VALLEJO	PESCADOR		4,40	61,60	21,84	16,56	FRANCOARENOSO	5,10	0,25	11,80	2,60	0,56	0,19	0,14	0,00	14,00	1,50	1,90	4,60	0,30	4,60	0,22	0,40	0,40	0,0
199	29.08.88	CESAR PIEDRAHITA VALLEJO	PESCADOR		4,30	55,60	27,84	20,56	FRANCOARCILLOARENOSO	4,10	0,18	13,20	5,10	0,34	0,10	0,17	0,00	13,60	1,70	1,30	4,60	0,30	3,00	0,22	0,40	0,40	0,0
200	29.08.88	CESAR PIEDRAHITA VALLEJO	PESCADOR		5,00	43,60	31,84	24,56	FRANCO	0,59	0,08	4,30	18,90	1,80	0,87	0,14	0,00	8,00	0,60	3,20	12,70	1,50	9,50	0,14	0,40	0,40	0,0
201	20.09.84	COL. SUSANA SANCHEZ DE VIVAS	PESCADOR		4,70	0,00	0,00	0,00		5,30	0,24	12,80	4,30	0,76	0,29	0,26	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	64,0
202	06.08.92	COLEGIO GUILLERMO L. VALENCIA	PESCADOR		5,20	0,00	0,00	0,00	FRANCOARENOSO	20,40	0,00	0,00	2,00	1,20	0,30	0,24	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
203	16.01.85	COMUNIDAD PAEZ	PESCADOR		4,60	81,08	8,92	10,00	ARENOSO FRNCO	7,60	0,44	10,00	2,70	0,48	0,11	0,20	0,00	29,20	1,90	0,00	0,00	0,00	4,50	0,05	0,00	0,00	71,0
204	26.08.82	ELIAS CLAROS	PESCADOR	1806	4,30	49,44	21,84	28,72	FRANCOARCILLOARENOSO	7,52	0,31	14,10	2,10	1,30	0,37	0,24	0,00	17,80	1,00	7,60	7,30	1,20	22,10	0,09	0,40	0,60	34,0
205	26.06.90	GERARDO G. TRUJILLO	PESCADOR	1579	4,90	0,00	0,00	0,00	FRANCOARENOSO	10,50	0,00	0,00	1,00	1,10	0,20	0,43	0,00	0,00	0,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
206	26.06.90	GERARDO G. TRUJILLO	PESCADOR	1532	4,90	0,00	0,00	0,00	FRANCOARENOSO	13,30	0,00	0,00	2,00	1,60	0,40	0,34	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
207	03.07.79	JAIME MARTINEZ	PESCADOR		5,40	0,00	0,00	0,00		6,57	0,28	13,60	2,40	0,65	0,42	1,10	0,43	18,20	0,50	3,60	2,80	0,50	0,00	0,06	0,60	0,02	0,0
208	03.07.79	JAIME MARTINEZ	PESCADOR		5,20	0,00	0,00	0,00		3,23	0,20	9,36	1,90	1,00	0,33	0,82	0,52	13,20	0,70	5,80	8,00	1,00	0,00	0,13	0,40	0,02	0,0
209	03.07.79	JAIME MARTINEZ	PESCADOR		5,20	0,00	0,00	0,00		4,23	0,18	13,60	3,10	0,45	0,29	0,77	0,41	12,40	1,70	7,60	6,20	0,80	0,00	0,03	0,40	1,00	0,0
210	01.06.90	JESUS H. MOSQUERA	PESCADOR		5,20	0,00	0,00	0,00	FRANCOARENOSO	9,70	0,00	0,00	4,00	1,90	0,30	0,51	0,00	0,00	0,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0

211	13.08.80	JORGE RAMIREZ	PESCADOR		5,10	0,00	0,00	0,00		7,38	0,37	0,00	2,77	0,41	0,11	0,64	0,00	0,00	1,90	0,00	0,00	0,00	8,40	1,11	0,40	0,40	62,0
212	30.11.90	JOSE H. MOSQUERA	PESCADOR		4,90	0,00	0,00	0,00	FRANCO ARENOSO	16,10	0,00	0,00	20,00	1,80	0,70	1,05	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
213	10.05.82	JUAN BOSCO FERNANDEZ	PESCADOR		4,70	35,60	26,56	37,84	FRANCO ARCILLOSO	4,98	0,10	28,90	1,83	0,72	0,25	0,16	0,50	13,80	2,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	70,5
214	06.08.90	MAURICIO ROMERO	PESCADOR		4,20	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	7,50	0,00	0,00	2,00	0,60	0,30	0,26	0,00	0,00	3,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
215	06.08.90	MAURICIO ROMERO	PESCADOR		4,40	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	6,10	0,00	0,00	4,00	1,30	0,70	0,26	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
216	06.08.90	MAURICIO ROMERO	PESCADOR		4,10	0,00	0,00	0,00	FRANCO ARCILLOSO	3,40	0,00	0,00	3,70	0,60	0,30	0,66	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
217	01.10.93	FABIO DAUQUI	PICACHO		4,90	72,16	21,84	6,00	FRANCO ARENOSO	17,50	0,50	20,30	2,40	0,40	0,30	0,31	0,00	19,20	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	56,3
218	10.05.82	ALVARO CORPUS	PIOYA		5,50	79,60	10,56	9,84	FRANCO ARENOSO	19,00	1,00	11,00	3,41	3,00	0,58	0,26	0,58	22,20	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
219	14.05.82	ANGEL MARIA CHILO	PIOYA	2530	5,10	70,88	19,12	10,00	FRANCO ARENOSO	15,80	0,52	17,60	3,70	0,77	0,27	0,26	9,44	20,60	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
220	10.05.82	CAROLINA CAMPO	PIOYA		5,80	54,88	25,12	20,00	FRANCO ARENOSO	9,10	0,31	17,00	6,82	6,55	1,58	0,87	0,67	19,80	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
221	10.05.82	JOSE CLIMACO CHILO	PIOYA		5,20	60,88	25,12	14,00	FRANCO ARENOSO	16,00	0,64	14,50	4,55	6,15	1,02	0,35	0,63	22,20	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
222	10.05.82	LAURENTINO CAMPO	PIOYA	2576	5,10	69,60	18,56	11,84	FRANCO ARENOSO	16,00	0,64	14,50	5,25	4,47	0,93	0,62	0,61	23,20	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
223	18.06.93	JOSE HERNAN MOSQUERA	POTRERILLO		4,90	64,88	24,56	10,56	FRANCO ARENOSO	6,86	0,32	12,40	5,30	1,70	0,57	1,10	0,00	15,20	0,60	4,00	4,00	0,40	8,00	0,08	0,40	0,40	15,1
224	22.09.93	MARINO PENA CHOCUE	PUEBLO NUEVO		4,10	76,16	18,40	5,44	ARENOSO FRANCO	27,72	1,19	12,00	4,70	1,10	0,40	0,25	0,00	22,20	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	55,7
225	31.03.93	CENTRO DE CAPACITACION	RESG. PUEBLO NVO		5,00	81,96	12,76	5,28	ARENOSO FRANCO	18,90	0,74	14,90	239,70	0,60	0,25	0,22	0,37	23,00	0,50	0,90	2,20	0,60	8,00	0,17	0,40	0,40	31,8
226	20.09.90	JOAQUIN CHOCUE	SAN ANTONIO		4,70	0,00	0,00	0,00	FRANCO ARCILLO LIMOSO	9,10	0,00	0,00	5,00	1,80	0,70	0,29	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
227	16.06.93	JOAQUIN CHOCUE	SAN ANTONIO		5,00	78,88	16,56	4,56	ARENOSO FRANCO	23,80	1,01	13,70	3,00	0,60	0,32	0,28	0,00	22,40	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	52,0
228	10.05.82	CLAUDIO DICUE	SAN JACINTO		5,30	66,88	22,56	10,56	FRANCO ARENOSO	12,70	0,63	11,70	4,27	5,00	1,29	0,72	0,61	21,20	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
229	07.12.92	ROBERT F. MUELAS	SAN PEDRO		4,90	72,88	21,84	5,28	FRANCO ARENOSO	18,08	0,63	16,65	8,31	2,00	0,31	0,42	0,00	21,60	0,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	42,9
230	16.06.93	JOSE RAMOS CAYAPU	SAN RAFAEL		5,00	78,88	18,56	2,56	ARENOSO FRANCO	22,62	1,16	11,30	2,70	1,50	0,69	0,31	0,00	23,00	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	19,4
231	06.08.92	ABIGAIL TROCHEZ	SIBERIA	1724	4,70	0,00	0,00	0,00	FRANCO ARENOSO	17,80	0,00	0,00	3,00	1,00	0,20	0,24	0,00	0,00	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
232	23.07.90	ALBA OROZCO	SIBERIA	1740	4,50	0,00	0,00	0,00	FRANCO ARENOSO	10,40	0,00	0,00	3,00	0,90	0,40	0,69	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
233	25.08.82	ALFONSO CIFUENTES	SIBERIA	1670	5,00	61,44	21,84	16,72	FRANCO ARENOSO	14,30	0,59	14,10	2,40	1,30	0,31	0,31	0,00	23,60	0,50	4,00	4,80	0,60	9,70	0,15	0,40	0,60	0,0
234	19.11.75	ARLEY LOZADA	SIBERIA		5,50	0,00	0,00	0,00		4,38	0,18	0,00	8,75	0,00	0,00	0,36	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
235	19.11.75	ARLEY LOZADA	SIBERIA		5,70	0,00	0,00	0,00		3,51	0,22	0,00	5,00	0,00	0,00	0,59	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
236	25.08.82	JAIME VILLANI	SIBERIA	1670	5,20	59,44	21,84	18,72	FRANCO ARENOSO	9,86	0,42	13,60	2,40	1,30	0,37	0,31	0,00	23,60	0,30	5,20	5,70	0,60	11,40	0,06	0,40	0,40	0,0
237	04.11.92	JOSE ANTONIO TOMBE	SIBERIA	1694	4,40	0,00	0,00	0,00	ARCILLO LIMOSO	11,90	0,00	0,00	3,00	1,00	0,30	0,20	0,00	0,00	4,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
238	25.09.69	LUIS P. SARRIA	SIBERIA		5,10	0,00	0,00	0,00		6,10	0,00	0,00	12,00	0,00	0,00	0,12	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
239	26.11.76	MEDARDO GARCIA	SIBERIA		4,70	0,00	0,00	0,00		11,40	0,57	0,00	1,57	0,00	0,00	0,21	0,00	0,00	4,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
240	16.07.91	MEDARDO GARCIA	SIBERIA		4,70	0,00	0,00	0,00	FRANCO ARENOSO	17,20	0,00	0,00	3,00	2,00	0,60	0,20	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
241	23.07.90	RAUL GALEANO	SIBERIA		4,20	0,00	0,00	0,00	FRANCO ARENOSO	7,90	0,00	0,00	1,00	0,30	0,20	0,26	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
242	08.01.70	SERAFIN TUMBO	SIBERIA		5,60	0,00	0,00	0,00	FRANCO	24,41	0,00	0,00	3,70	0,00	0,00	0,21	0,00	0,00	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
243	08.01.70	SERAFIN TUMBO	SIBERIA		5,50	0,00	0,00	0,00	FRANCO	22,02	0,00	0,00	3,30	0,00	0,00	0,21	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
244	22.11.93	SILVIO M. PALTA	SIBERIA	1750	4,60	0,00	0,00	0,00	ARENOSO FRANCO	10,50	0,00	0,00	8,00	3,00	1,30	0,72	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
245	02.11.90	ARISTOBULO URREGO	STA BARBARA		4,20	0,00	0,00	0,00	FRANCO	9,30	0,00	0,00	1,00	1,00	0,30	0,29	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
246	02.11.90	ARISTOBULO URREGO	STA BARBARA		4,10	0,00	0,00	0,00	FRANCO ARCILLOSO	6,70	0,00	0,00	1,00	1,50	0,50	0,29	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
247	30.11.90	LUIS E. SANDOVAL	STA BARBARA		4,20	0,00	0,00	0,00	FRANCO ARENOSO	21,20	0,00	0,00	2,00	0,30	0,20	0,48	0,00	0,00	4,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
248	19.05.82	BELARMINO TROCHEZ	VENTANAS		4,80	72,88	15,12	12,00	FRANCO ARENOSO	11,00	0,27	23,60	2,71	0,60	0,18	0,22	0,44	24,80	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	60,0
249	04.02.94	CARLOS E. FERNANDEZ	VENTANAS	1694	4,90	0,00	0,00	0,00	FRANCO ARENOSO	7,80	0,00	0,00	4,00	1,00	0,50	0,47	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
250	30.11.90	HELMER PENA	VENTANAS		4,20	0,00	0,00	0,00	FRANCO ARENOSO	9,40	0,00	0,00	9,00	0,40	0,10	0,34	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
251	30.11.90	HELMER PENA	VENTANAS		4,20	0,00	0,00	0,00	FRANCO ARENOSO	11,50	0,00	0,00	2,00	0,30	0,10	0,33	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
252	30.11.90	HELMER PENA	VENTANAS		4,60	0,00	0,00	0,00	FRANCO ARENOSO	9,40	0,00	0,00	2,00	0,30	0,10	0,26	0,00	0,00	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
253	08.01.70	JOSE ANTONIO PECHENE	VENTANAS	1715	5,20	0,00	0,00	0,00	FRANCO	8,87	0,00	0,00	3,20	0,00	0,00	0,18	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
254	22.11.93	LUIS E. BUENAVENTURA	VENTANAS		5,70	0,00	0,00	0,00	FRANCO ARENOSO	7,20	0,00	0,00	3,00	3,40	1,30	0,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
255	19.12.94	LUZ ADIELA ROSAS	VENTANAS		5,10	0,00	0,00	0,00	FRANCO ARENOSO	0,00	0,00	0,00	9,00	6,50	2,20	0,36	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
256	30.11.90	OFELIA GOMEZ	VENTANAS		4,60	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	16,50	0,00	0,00	2,00	0,50	0,20	0,48	0,00	0,00	0,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
257	04.11.92	OLIVERIO TROCHEZ	VENTANAS		4,80	0,00	0,00	0,00	FRANCO ARENOSO	14,40	0,00	0,00	3,00	2,20	0,60	0,56	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
258	27.09.91	DENIS PAZ	ZONA URBANA		4,10	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	8,50	0,00	0,00	1,00	0,60	0,50	0,20	0,00	0,00	4,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
259	27.09.91	DENIS PAZ	ZONA URBANA		4,20	0,00	0,00	0,00	FRANCO ARENOSO	6,90	0,00	0,00	2,00	1,00	0,70	0,17	0,00	0,00	2,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
260	27.09.91	DENIS PAZ	ZONA URBANA		4,20	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	7,10	0,00	0,00	1,00	0,80	0,60	0,19	0,00	0,00	3,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
261	27.09.91	DENIS PAZ	ZONA URBANA		4,20	0,00	0,00	0,00	FRANCO ARCILLOARENOSO	5,10	0,00	0,00	1,00	0,70	0,50	0,17	0,00	0,00	4,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
262	23.03.82	ADELMO VARGAS			4,60	70,88	20,56	8,56	FRANCO ARENOSO	7,70	0,34	13,10	3,50	0,45	0,21	0,18	0,35	29,20	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	73,2
263	25.09.69	AGUSTIN REYES			4,90	0,00	0,00	0,00		16,90	0,00	0,00	14,80	0,00	0,00	0,19	0,00	0,00	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
264	25.09.69	AGUSTIN REYES			5,20	0,00	0,00	0,00		18,00	0,00	0,00	8,30	0,00	0,00	0,21	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0

265	21.10.68	ALFONSO HERNANDEZ	5,20	0,00	0,00	0,00		10,40	0,00	0,00	2,30	1,26	0,00	0,18	0,00	0,00	1,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
266	24.04.69	ALFONSO PAZ	4,90	0,00	0,00	0,00		14,00	0,00	0,00	2,80	0,00	0,00	0,71	0,00	0,00	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
267	03.11.93	ALFREDO OSNA	5,30	69,44	26,56	4,00	FRANCO ARENOSO	24,96	0,92	15,70	1,70	1,00	0,37	0,33	0,00	21,60	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	48,5
268	27.10.93	ANONIAS ROCHA	5,10	70,36	24,36	5,28	FRANCO ARENOSO	24,10	0,87	16,10	1,90	0,60	0,31	0,31	0,00	20,40	1,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	47,4
269	25.09.69	AQUILEO VIVAS	4,70	0,00	0,00	0,00	FRANCO	9,90	0,00	0,00	8,40	0,00	0,00	0,21	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
270	23.09.69	ARISTIDES BETANCOURT	5,00	0,00	0,00	0,00	FRANCO	15,20	0,00	0,00	4,30	0,00	0,00	0,19	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
271	08.01.70	ARISTIDES BETANCOURT	5,10	0,00	0,00	0,00	FRANCO ARENOSO	8,39	0,00	0,00	4,60	0,00	0,00	0,24	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
272	22.06.89	ARMANDO FOLLECO	4,60	75,96	14,74	9,30	FRANCO ARENOSO	9,20	0,42	12,70	2,80	0,34	0,12	0,26	0,00	19,60	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	67,5
273	08.01.70	ARTEMIO H. GARCIA	5,20	0,00	0,00	0,00		18,17	0,00	0,00	2,00	0,00	0,00	0,20	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
274	07.10.75	ARTURO RENGIFO	5,60	0,00	0,00	0,00		5,49	0,27	0,00	15,75	0,00	0,00	0,56	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
275	08.01.70	AURELIO VARGAS	5,20	0,00	0,00	0,00	FRANCO ARENOSO	7,17	0,00	0,00	2,50	0,00	0,00	0,36	0,00	0,00	1,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
276	04.11.81	AVELINO RAMOS	5,00	0,00	0,00	0,00		16,00	0,80	0,00	1,68	1,55	0,19	0,19	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
277	04.11.81	AVELINO RAMOS	4,70	0,00	0,00	0,00		12,00	0,60	0,00	2,59	0,33	0,05	0,14	0,00	0,00	1,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
278	02.11.93	BELARMINO CAMPO CHOCUE	5,10	67,44	24,56	8,00	FRANCO ARENOSO	13,62	0,87	9,10	2,90	0,75	0,21	0,28	0,00	16,20	1,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	49,2
279	02.11.93	BERNARDO NENE COLLAZOS	5,20	75,44	18,56	6,00	FRANCO ARENOSO	13,50	0,52	15,00	3,70	1,10	0,29	0,33	0,00	16,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	46,6
280	25.09.69	BRAULIO CASSO	4,50	0,00	0,00	0,00		17,80	0,00	0,00	7,40	0,00	0,00	0,15	0,00	0,00	3,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
281	16.11.93	CABILDO INDIGENA	5,10	83,44	14,00	2,56	ARENOSO FRANCO	16,54	0,67	14,30	3,10	1,10	0,41	0,34	0,00	19,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	41,3
282	02.11.93	CARLOS NENE	4,80	58,36	34,36	7,28	FRANCO ARENOSO	13,08	0,49	15,50	2,40	1,00	0,41	0,31	0,00	18,00	3,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	67,7
283	08.01.69	CAYETANO IPIA FERNANDEZ	4,60	0,00	0,00	0,00	FRANCO ARENOSO	10,07	0,00	0,00	5,30	0,00	0,00	0,24	0,00	0,00	4,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
284	11.03.86	CLAUDIO SOLARTE	5,10	71,60	22,56	5,84	FRANCO ARENOSO	20,60	0,71	16,80	3,20	0,50	0,17	0,29	0,00	29,60	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	65,0
285	06.02.81	COL. GUILLERMO L. VALENCIA	5,20	59,44	17,28	23,28	FRANCO ARCILLOSO	7,00	0,28	14,50	2,40	0,88	0,51	0,94	0,00	0,00	2,00	2,90	6,40	0,50	11,96	0,11	0,40	0,80	0,0
286	23.11.88	COL. SUSANA TROCHEZ DE VIVAS	4,80	0,00	0,00	0,00		6,00	0,27	12,90	16,30	1,40	0,29	0,21	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,05	0,00	0,00	45,0
287	23.11.88	COL. SUSANA TROCHEZ DE VIVAS	4,60	0,00	0,00	0,00		8,60	0,34	14,70	17,30	0,82	0,19	0,21	0,00	0,00	2,40	0,00	0,00	0,00	0,00	0,05	0,00	0,00	67,0
288	23.11.88	COL. SUSANA TROCHEZ DE VIVAS	4,50	0,00	0,00	0,00		6,00	0,26	13,40	4,90	0,82	0,29	0,21	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,20	0,00	0,00	63,0
289	28.07.82	DARIO SANDOVAL	4,90	42,88	27,84	29,28	FRANCO ARCILLOSO	5,90	0,24	14,25	2,63	2,45	0,54	0,08	0,56	27,60	1,00	6,52	17,20	0,72	15,80	0,15	0,40	0,40	0,0
290	28.11.75	DOMINCIANO VILLANI	5,10	0,00	0,00	0,00		3,20	0,16	0,00	1,20	0,00	0,00	0,18	0,00	0,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
291	08.01.70	ENRIQUE NIETO	4,90	0,00	0,00	0,00	FRANCO ARENOSO	7,43	0,00	0,00	2,80	0,00	0,00	0,24	0,00	0,00	3,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
292	02.11.93	EUCLIDES PENA	5,40	67,44	26,56	6,00	FRANCO ARENOSO	23,66	0,80	17,10	2,50	1,60	0,52	0,25	0,00	22,40	0,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	22,8
293	08.01.70	FERMIN OSNAS	5,40	0,00	0,00	0,00	FRAN CO	19,63	0,00	0,00	3,70	0,00	0,00	0,21	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
294	25.09.69	FLOREMIRO FERNANDEZ	5,20	0,00	0,00	0,00		21,20	0,00	0,00	7,60	0,00	0,00	0,37	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
295	02.11.93	FLORESMIRO TUMBO GUETIO	5,20	77,44	18,56	4,00	ARENOSO FRANCO	21,82	0,84	15,10	2,40	1,60	0,44	0,37	0,00	21,00	1,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33,2
296	03.11.93	GILBERTO YAPUE	5,00	58,36	30,36	11,28	FRANCO ARENOSO	7,78	0,35	12,90	1,50	3,20	1,20	0,28	0,00	15,80	3,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	39,8
297	19.10.93	GRANJA INST. TEC. SUSANA TROCHEZ	5,00	0,00	0,00	0,00	FRANCO	4,70	0,00	0,00	4,00	0,80	0,30	0,42	0,00	0,00	2,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
298	19.10.93	GRANJA INST. TEC. SUSANA TROCHEZ	5,40	0,00	0,00	0,00	FRANCO ARCILLOSO	5,20	0,00	0,00	16,00	4,70	0,80	0,38	0,00	0,00	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
299	23.03.82	GREGORIO BOMBA	4,40	66,88	25,12	8,00	FRANCO ARENOSO	17,60	0,59	17,30	2,90	0,49	0,18	0,13	0,35	24,00	2,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	73,3
300	26.11.68	HERNAN ZAPE	4,80	0,00	0,00	0,00		8,13	0,00	0,00	2,00	1,89	0,00	0,22	0,00	0,00	3,65	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
301	18.08.87	HOGAR JUVENIL	5,40	79,90	13,50	6,60	ARENOSO FRANCO	18,90	0,82	13,40	1,90	0,91	0,23	0,27	0,00	0,00	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30,0
302	18.08.87	HOGAR JUVENIL	4,80	83,90	9,50	6,60	ARENOSO FRANCO	21,80	0,90	14,10	3,50	0,79	0,25	0,17	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	60,0
303	18.08.87	HOGAR JUVENIL	5,00	41,90	29,50	28,60	FRANCO ARCILLOSO	3,90	0,10	22,70	5,80	1,70	0,27	0,19	0,00	0,00	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	41,0
304	17.11.82	HOGAR JUVENIL CAMPESINO	5,20	54,88	28,56	16,56	FRANCO ARENOSO	7,40	0,41	10,50	19,40	3,30	0,95	0,64	0,67	13,40	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	14,0
305	17.11.82	HOGAR JUVENIL CAMPESINO	5,30	50,16	27,84	22,00	FRANCO	6,30	0,39	9,40	2,80	2,80	0,83	0,22	0,63	16,20	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	13,0
306	20.09.84	HOGAR JUVENIL CAMPESINO	5,00	0,00	0,00	0,00		4,50	0,20	13,05	15,10	1,50	0,56	0,29	0,00	0,00	1,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	32,0
307	23.11.93	HOGAR JUVENIL CAMPESINO	4,30	57,44	22,00	20,56	FRANCO ARCILLOARENOSO	6,28	0,29	12,60	2,80	1,70	0,77	0,23	0,00	13,80	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	34,1
308	23.11.93	HOGAR JUVENIL CAMPESINO	4,30	59,44	32,00	8,56	FRANCO ARENOSO	6,50	0,24	15,70	3,30	4,90	1,80	0,37	0,00	22,00	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
309	23.11.93	HOGAR JUVENIL CAMPESINO	5,60	61,44	24,00	14,56	FRANCO ARENOSO	7,16	0,32	13,00	8,70	4,10	1,00	0,34	0,00	19,20	0,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	9,9
310	03.11.93	HUBERT A. CHOCUE	5,00	68,36	26,36	5,28	FRANCO ARENOSO	20,10	0,76	15,30	2,70	0,52	0,19	0,23	0,00	20,80	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	63,0
311	23.09.69	JESUS A. PECHENE	5,40	0,00	0,00	0,00	FRANCO	17,80	0,00	0,00	8,40	0,00	0,00	0,28	0,00	0,00	1,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
312	25.09.69	JESUS M. SARRIA	5,50	0,00	0,00	0,00		4,80	0,00	0,00	3,90	0,00	0,00	0,26	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
313	04.11.81	JESUS RAMOS	4,40	0,00	0,00	0,00		14,30	0,71	0,00	4,62	0,70	0,08	0,14	0,00	0,00	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
314	08.01.70	JOAQUIN ANTONIO GIRON	5,10	0,00	0,00	0,00	ARCILLOSO	5,28	0,00	0,00	2,50	0,00	0,00	0,21	0,00	0,00	2,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
315	23.09.69	JOAQUIN GIRON	5,00	0,00	0,00	0,00	FRANCO	9,40	0,00	0,00	8,40	0,00	0,00	0,22	0,00	0,00	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
316	04.11.69	JORGE BELALCAZAR	5,20	0,00	0,00	0,00	FRANCO	17,60	0,00	0,00	2,50	0,00	0,00	0,23	0,00	0,00	1,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
317	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	5,20	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,90	1,30	4,80	6,80	3,20	0,00	0,00	0,00	0,0
318	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	5,30	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,20	1,80	10,20	4,40	3,20	0,00	0,00	0,00	0,0

319	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	5,40	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,20	0,60	2,00	0,00	2,40	0,00	0,00	0,00	0,0
320	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	5,40	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,20	1,20	0,80	0,40	4,90	0,00	0,00	0,00	0,0
321	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	5,50	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,10	0,80	2,00	0,00	2,40	0,00	0,00	0,00	0,0
322	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	4,70	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3,70	5,54	10,60	8,60	2,00	0,00	0,00	0,00	0,0
323	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	4,90	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3,70	2,80	5,60	3,30	2,80	0,00	0,00	0,00	0,0
324	18.09.80	JORGE GONZALEZ (INTEC-ICEL)	5,90	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,60	4,00	0,60	10,20	0,00	0,00	0,00	0,0
325	23.03.82	JORGE PELENE	4,00	38,88	36,56	24,56	FRANCO	4,45	0,28	9,20	2,45	0,63	0,23	0,13	0,39	13,60	3,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	76,4
326	04.11.81	JORGE RAMOS	5,00	0,00	0,00	0,00		16,20	0,81	0,00	3,68	2,05	0,20	0,20	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
327	23.09.69	JOSE ALDEMAR RAMIREZ	5,20	0,00	0,00	0,00	FRANCO	11,00	0,00	0,00	4,30	0,00	0,00	0,19	0,00	0,00	1,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
328	07.01.82	JOSE CLIMACO CHILO	5,90	0,00	0,00	0,00		13,10	0,65	0,00	5,43	5,00	5,00	0,42	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
329	07.01.82	JOSE CLIMACO CHILO	5,00	0,00	0,00	0,00		13,00	0,65	0,00	4,10	2,79	2,79	0,48	0,00	0,00	0,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
330	08.01.70	JOSE VICENTE BENACHI	5,00	0,00	0,00	0,00	FRANCO ARENOSO	8,02	0,00	0,00	1,80	0,00	0,00	0,39	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
331	08.01.70	JUAN ANTONIO PAJA	4,90	0,00	0,00	0,00	FRANCO ARENOSO	17,24	0,00	0,00	3,90	0,00	0,00	0,24	0,00	0,00	3,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
332	23.03.82	LEONARDO YOTENGO	4,90	70,88	14,56	14,56	FRANCO ARENOSO	9,50	0,43	12,80	2,45	1,40	0,48	0,28	0,48	18,60	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	41,0
333	02.11.93	LEONIDAS CHOCUE	5,40	64,36	30,36	5,28	FRANCO ARENOSO	23,34	0,76	17,80	2,50	1,70	0,75	0,34	0,00	22,20	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	39,2
334	29.03.82	LISANDRO BOMBA	4,30	42,88	25,12	32,00	FRANCO ARCILLOSO	5,60	0,21	15,46	1,80	1,10	0,46	0,17	0,37	13,60	2,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	60,9
335	28.06.79	LORENZO BAMBA	5,10	0,00	0,00	0,00		8,24	0,41	11,70	2,70	0,70	0,19	0,53	0,52	27,60	2,10	0,00	0,00	0,00	0,00	0,15	0,00	0,00	60,0
336	08.01.70	LUIS ALVARO BETANCOURT	5,10	0,00	0,00	0,00	FRANCO ARENOSO	14,37	0,00	0,00	3,50	0,00	0,00	0,19	0,00	0,00	3,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
337	23.12.92	LUZ ANGELA TOVAR	4,50	59,24	22,74	18,02	FRANCO ARENOSO	11,24	0,28	23,28	3,20	1,20	0,42	0,24	0,00	18,00	2,30	1,10	2,20	0,40	15,80	0,08	0,40	0,40	55,3
338	04.11.81	MARCO T. CORPUS	4,80	0,00	0,00	0,00		10,30	0,51	0,00	3,68	0,45	0,08	0,14	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
339	04.11.81	MARCO T. CORPUS	5,00	0,00	0,00	0,00		13,50	0,67	0,00	3,50	7,85	1,34	0,85	0,00	0,00	0,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
340	04.06.92	MARCO TULIO ZAPATA	5,30	80,32	12,76	6,92	ARENOSO FRANCO	19,76	0,74	15,36	3,80	1,00	0,54	0,15	0,00	34,80	1,10	1,50	9,50	0,60	3,20	0,06	0,40	0,40	39,4
341	07.05.82	MARIO GUETIO	4,70	45,60	24,56	29,84	FRANCO ARCILLOSO	5,90	0,20	17,10	3,50	0,85	0,35	0,16	0,44	18,80	2,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	65,0
342	08.01.70	MERCEDARIO CAMPO	5,20	0,00	0,00	0,00	FRANCO ARENOSO	13,17	0,00	0,00	3,30	0,00	0,00	0,24	0,00	0,00	3,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
343	04.11.81	MIGUEL BUCUE	4,50	0,00	0,00	0,00		17,00	0,85	0,00	22,21	0,30	0,06	0,14	0,00	0,00	2,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
344	04.11.81	MIGUEL BUCUE	4,70	0,00	0,00	0,00		14,20	0,71	0,00	4,17	1,55	0,23	0,25	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
345	03.11.93	MILVIA VIVAS	5,10	69,44	26,56	4,00	FRANCO ARENOSO	24,64	0,87	16,40	1,70	1,10	0,39	0,27	0,00	20,20	0,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33,8
346	08.01.70	MISAEL PENA	5,40	0,00	0,00	0,00	FRANCO	22,02	0,00	0,00	3,00	0,00	0,00	0,24	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
347	04.11.69	NOE VALENCIA	5,20	0,00	0,00	0,00	FRANCO ARCILLOSO	5,90	0,00	0,00	3,00	0,00	0,00	0,21	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
348	31.03.82	OBDULIO VARGAS	4,50	66,88	25,12	8,00	FRANCO ARENOSO	25,50	0,76	19,50	2,70	0,45	0,19	0,19	0,35	34,40	2,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	77,1
349	02.11.93	OSCAR PAJA	5,80	69,44	22,56	8,00	FRANCO ARENOSO	14,26	0,69	12,00	3,50	8,20	2,20	0,61	0,74	20,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
350	02.11.93	OSCAR PAJA	5,00	71,44	24,56	4,00	FRANCO ARENOSO	24,86	1,54	9,40	1,70	2,60	0,64	0,36	0,67	20,80	1,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	23,4
351	03.08.83	OSWALDO VILLANI	5,40	78,80	16,40	4,80	ARENOSO FRANCO	15,80	0,57	16,10	2,20	0,46	0,25	0,28	0,00	24,20	1,80	1,30	5,10	0,80	4,40	0,10	0,40	2,40	65,0
352	07.01.82	PEDRO JOSE CAMPO	4,90	0,00	0,00	0,00		9,60	0,48	0,00	2,59	1,44	0,15	0,18	0,00	0,00	1,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
353	07.01.82	PEDRO JOSE CAMPO	4,80	0,00	0,00	0,00		7,30	0,36	0,00	4,38	4,89	0,84	0,51	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
354	24.09.69	PEDRO SARRIA	4,80	0,00	0,00	0,00		4,40	0,00	0,00	3,90	0,00	0,00	0,08	0,00	0,00	1,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
355	30.09.94	RICARDO MARINO	5,10	78,16	18,72	3,12	ARENOSO FRANCO	17,00	0,59	16,70	1,70	0,97	0,23	0,37	0,00	22,00	1,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	47,1
356	30.09.94	RICARDO MARINO	5,70	80,16	18,72	1,12	ARENOSO FRANCO	2,89	0,13	12,90	1,05	0,53	0,18	0,20	0,00	7,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
357	30.09.94	RICARDO MARINO	5,30	70,16	26,72	3,12	FRANCO ARENOSO	8,04	0,36	13,00	1,10	0,80	0,30	0,26	0,00	15,20	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	21,5
358	30.09.94	RICARDO MARINO	5,50	74,16	24,72	1,12	ARENOSO FRANCO	1,44	0,07	11,90	1,30	0,41	0,08	0,21	0,00	9,60	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	22,1
359	04.11.69	ROBERTO MUNOZ	4,80	0,00	0,00	0,00	FRANCO ARCILLOSO	5,80	0,00	0,00	2,80	0,00	0,00	0,41	0,00	0,00	1,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
360	27.10.93	SILVERIO YOJO	5,70	77,44	18,56	4,00	ARENOSO FRANCO	24,10	0,94	14,90	2,70	4,10	0,62	0,47	0,00	22,60	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
361	03.11.93	SILVERIO YOJO	5,60	77,44	18,56	4,00	ARENOSO FRANCO	25,40	1,13	13,00	3,10	0,75	0,23	0,41	0,00	22,00	1,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	46,3
362	12.11.93	SINFOROSO CAMPO	5,20	75,44	20,00	4,56	ARENOSO FRANCO	18,64	0,55	19,60	3,10	1,10	0,39	0,38	0,00	15,60	2,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	55,2
363	02.11.93	VICENTE PENA	5,60	75,44	18,56	6,00	FRANCO ARENOSO	7,34	0,27	15,70	4,40	3,50	1,00	0,31	0,00	15,20	0,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
364	25.09.69	VICTOR VELASCO	5,40	0,00	0,00	0,00		12,60	0,00	0,00	8,20	0,00	0,00	1,12	0,00	0,00	0,40	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
365	04.11.81	ZOILO BACUE	4,60	0,00	0,00	0,00		21,60	1,10	0,00	1,82	1,64	0,08	0,14	0,00	0,00	1,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0

Appendix 5: The cluster producers for soil analysis

The CLUSTER Procedure
Average Linkage Cluster Analysis

Eigenvalues of the Covariance Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	11.2083136	4.9492140	0.5398	0.5398
2	6.2590997	3.9025246	0.3014	0.8413
3	2.3565751	1.5624048	0.1135	0.9547
4	0.7941703	0.6487220	0.0382	0.9930
5	0.1454482		0.0070	1.0000

Root-Mean-Square Total-Sample Standard Deviation = 2.037823
Root-Mean-Square Distance Between Observations = 6.444161

Cluster History

NCL	--Clusters	Joined---	FREQ	PSF	PST2	Norm RMS Dist	Tie
42	AN9	AP6	2	.	.	0	T
41	AO9	AQ3	2	.	.	0	
40	AB6	U11	2	1884	.	0.0414	
39	CL41	I6	3	524	.	0.071	
38	V6	H6	2	302	.	0.1018	
37	AF9	AA8	2	203	.	0.1251	
36	CL38	Y9	3	153	2.0	0.1335	
35	E0	D6	2	135	.	0.1344	
34	AK11	T9	2	103	.	0.1963	
33	CL42	N0	3	76.6	.	0.2108	
32	AG0	CL37	3	65.6	3.5	0.2133	
31	Q0	J6	2	60.4	.	0.2241	
30	AI0	B6	2	56.7	.	0.231	
29	CL36	CL40	5	46.3	11.0	0.2349	
28	CL39	C9	4	42.3	28.5	0.2551	
27	CL31	O0	3	41.1	1.5	0.263	
26	CL33	R8	4	39.4	3.1	0.2673	
25	CL34	G6	3	38.8	2.2	0.2686	
24	S8	W9	2	38.6	.	0.292	
23	CL32	AE0	4	37.6	3.1	0.2936	
22	CL25	CL26	7	34.0	3.8	0.3163	
21	CL23	CL24	6	32.0	2.9	0.3412	
20	CL29	AM11	6	30.5	5.5	0.3755	
19	P6	I6	2	30.3	.	0.4071	
18	CL22	CL35	9	27.0	5.6	0.4094	
17	F0	A8	2	27.5	.	0.4172	
16	CL18	CL30	11	25.6	3.9	0.437	
15	CL20	CL28	10	21.6	13.8	0.4576	
14	CL21	M9	7	22.1	3.2	0.4587	

13	CL27	Z0	4	22.4	5.8	0.5145
12	X6	AH0	2	23.5	.	0.5297
11	CL14	CL16	18	19.2	11.2	0.5385
10	CL19	AJ6	3	19.9	3.2	0.6673
9	CL13	CL11	22	16.9	9.4	0.6752
8	CL9	CL15	32	11.7	17.0	0.708
7	AC8	AL6	2	13.2	.	0.7496
6	CL12	CL7	4	14.6	2.3	0.8305
5	CL8	CL6	36	12.9	9.4	0.9592
4	CL5	CL17	38	13.4	6.1	1.019
3	CL4	K6	39	15.8	5.2	1.3022
2	CL10	CL3	42	14.9	12.5	1.3143
1	CL2	AD6	43	.	14.9	2.4698

The CLUSTER Procedure
Centroid Hierarchical Cluster Analysis

Eigenvalues of the Covariance Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	11.2083136	4.9492140	0.5398	0.5398
2	6.2590997	3.9025246	0.3014	0.8413
3	2.3565751	1.5624048	0.1135	0.9547
4	0.7941703	0.6487220	0.0382	0.9930
5	0.1454482		0.0070	1.0000

Root-Mean-Square Total-Sample Standard Deviation = 2.037823
Root-Mean-Square Distance Between Observations = 6.444161

Cluster History

NCL	--Clusters Joined---		FREQ	PSF	PST2	Norm Cent Dist	Tie
42	AN9	AP6	2	.	.	0	T
41	AO9	AQ3	2	.	.	0	
40	AB6	U11	2	1884	.	0.0414	
39	CL41	I6	3	524	.	0.071	
38	V6	H6	2	302	.	0.1018	
37	CL38	Y9	3	179	2.0	0.1234	
36	AF9	AA8	2	153	.	0.1251	
35	E0	D6	2	135	.	0.1344	
34	AK11	T9	2	103	.	0.1963	
33	AG0	CL36	3	78.4	3.5	0.2039	
32	CL42	N0	3	65.6	.	0.2108	
31	CL37	CL40	5	48.3	11.0	0.2228	
30	Q0	J6	2	47.2	.	0.2241	
29	AI0	B6	2	46.3	.	0.231	
28	CL34	CL32	5	39.5	4.1	0.236	
27	CL30	O0	3	38.7	1.5	0.2379	
26	CL39	C9	4	37.2	28.5	0.2529	

25	W9	CL28	6	35.8	1.8	0.2533
24	CL25	R8	7	35.0	1.6	0.2503
23	CL33	AE0	4	34.5	3.1	0.2727
22	G6	CL35	3	34.5	5.7	0.278
21	CL23	S8	5	33.8	2.3	0.2961
20	CL24	CL29	9	29.4	4.8	0.3307
19	CL31	AM11	6	28.6	5.5	0.3547
18	CL20	CL22	12	23.6	6.1	0.3623
17	P6	I6	2	24.3	.	0.4071
16	CL19	CL26	10	20.3	13.8	0.408
15	CL21	M9	6	20.6	3.5	0.4125
14	F0	A8	2	21.9	.	0.4172
13	CL15	CL18	18	17.2	10.8	0.4265
12	Z0	CL13	19	17.8	1.8	0.4523
11	X6	AH0	2	19.2	.	0.5297
10	CL12	CL16	29	11.4	21.7	0.5687
9	CL27	CL10	32	10.6	5.6	0.5762
8	CL17	AJ6	3	11.7	3.2	0.6355
7	CL9	CL11	34	11.6	4.7	0.6766
6	AC8	AL6	2	13.5	.	0.7496
5	CL7	CL6	36	12.9	7.1	0.8771
4	CL5	CL14	38	13.4	6.1	0.8718
3	CL8	CL4	41	10.0	13.9	1.1495
2	CL3	K6	42	14.9	4.0	1.1952
1	CL2	AD6	43	.	14.9	2.3944

	pH	Carbono	Fosforo	Aluminio	CIC
	Mean	Mean	Mean	Mean	Mean
CLUSTER					
1	5.06	7.66	2.63	1.47	5.04
2	4.17	0.87	1.13	2.39	4.09
3	5.40	12.25	5.85	1.41	5.02
4	5.10	5.70	9.00	3.22	8.66
5	5.70	11.20	14.20	0.50	14.66

Appendix 6: Cluster Analysis between soils analysis and weeds

CORR Procedure

5 Variables: pH Carbono Fosforo Aluminio CIC

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
pH	43	5.02930	0.48758	216.26000	3.70000	6.20000
Carbono	43	7.43651	2.69369	319.77000	0.10000	13.00000
Fosforo	43	3.09070	2.49619	132.90000	0.54000	14.20000
Aluminio	43	1.54953	1.12308	66.63000	0.31000	4.53000
CIC	43	5.27907	2.40367	227.00000	1.66000	14.66000

Pearson Correlation Coefficients, N = 43
Prob > |r| under H0: Rho=0

	pH	Carbono	Fosforo	Aluminio	CIC
pH	1.00000	0.42229	0.39687	-0.40521	0.16222
		0.0048	0.0084	0.0070	0.2987
Carbono	0.42229	1.00000	0.31690	-0.21506	0.15585
	0.0048		0.0384	0.1661	0.3183
Fosforo	0.39687	0.31690	1.00000	-0.05250	0.64076
	0.0084	0.0384		0.7381	<.0001
Aluminio	-0.40521	-0.21506	-0.05250	1.00000	0.33987
	0.0070	0.1661	0.7381		0.0258
CIC	0.16222	0.15585	0.64076	0.33987	1.00000
	0.2987	0.3183	<.0001	0.0258	

The PRINCOMP Procedure

Observations	43
Variables	5

Simple Statistics

	pH	Carbono	Fosforo	Aluminio	CIC
Mean	5.029302326	7.436511628	3.090697674	1.549534884	5.279069767
StD	0.487576101	2.693691823	2.496190808	1.123082394	2.403667648

Correlation Matrix

	pH	Carbono	Fosforo	Aluminio	CIC
pH	1.0000	0.4223	0.3969	-.4052	0.1622
Carbono	0.4223	1.0000	0.3169	-.2151	0.1559
Fosforo	0.3969	0.3169	1.0000	-.0525	0.6408
Aluminio	-.4052	-.2151	-.0525	1.0000	0.3399
CIC	0.1622	0.1559	0.6408	0.3399	1.0000

Eigenvalues of the Correlation Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	2.09509844	0.56358033	0.4190	0.4190
2	1.53151811	0.85962388	0.3063	0.7253
3	0.67189423	0.22148546	0.1344	0.8597
4	0.45040877	0.19932831	0.0901	0.9498
5	0.25108046		0.0502	1.0000

Eigenvectors

	Prin1	Prin2	Prin3	Prin4	Prin5
pH	0.509556	-.325890	-.192798	0.771019	0.050072
Carbono	0.455779	-.215808	0.844081	-.179209	-.033238
Fosforo	0.570649	0.250321	-.302197	-.386455	0.609121
Aluminio	-.175096	0.676584	0.382757	0.472988	0.375972
CIC	0.419903	0.571661	-.111942	-.018692	-.695705

The CLUSTER Procedure
Ward's Minimum Variance Cluster Analysis

Eigenvalues of the Covariance Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	11.2083136	4.9492140	0.5398	0.5398
2	6.2590997	3.9025246	0.3014	0.8413
3	2.3565751	1.5624048	0.1135	0.9547
4	0.7941703	0.6487220	0.0382	0.9930
5	0.1454482		0.0070	1.0000

Root-Mean-Square Total-Sample Standard Deviation = 2.037823
Root-Mean-Square Distance Between Observations = 6.444161

Cluster History

NCL	Clusters Joined		FREQ	SPRSQ	RSQ	Tie
42	an-9	ap-6	2	0.0000	1.00	T
41	ao-9	aq-3	2	0.0000	1.00	
40	u-11	ab-6	2	0.0000	1.00	
39	i-6	CL41	3	0.0002	1.00	
38	h-6	v-6	2	0.0002	1.00	
37	aa-8	af-9	2	0.0004	.999	
36	d-6	e-0	2	0.0004	.999	
35	CL38	y-9	3	0.0005	.998	
34	t-9	ak-11	2	0.0009	.997	
33	j-6	q-0	2	0.0012	.996	
32	b-6	ai-0	2	0.0013	.995	
31	CL37	ag-0	3	0.0013	.994	
30	n-0	CL42	3	0.0014	.992	
29	CL33	o-0	3	0.0018	.990	
28	c-9	f-0	2	0.0018	.989	
27	g-6	CL34	3	0.0020	.987	
26	s-8	w-9	2	0.0020	.984	
25	CL30	r-8	4	0.0022	.982	
24	CL31	ae-0	4	0.0027	.980	
23	CL35	CL40	5	0.0028	.977	
22	l-6	p-6	2	0.0039	.973	
21	m-9	CL25	5	0.0046	.968	
20	CL26	CL24	6	0.0046	.964	
19	CL36	CL27	5	0.0046	.959	
18	CL23	am-11	6	0.0050	.954	
17	x-6	ah-0	2	0.0067	.947	
16	CL28	CL39	5	0.0071	.940	
15	CL32	CL21	7	0.0076	.933	
14	CL29	z-0	4	0.0087	.924	
13	CL22	aj-6	3	0.0128	.911	
12	ac-8	al-6	2	0.0134	.898	
11	CL15	CL19	12	0.0180	.880	
10	a-8	CL16	6	0.0187	.861	
9	CL17	CL12	4	0.0228	.838	
8	CL14	CL20	10	0.0231	.815	
7	CL18	CL8	16	0.0350	.780	
6	CL11	k-6	13	0.0404	.740	
5	CL6	CL9	17	0.0560	.684	
4	CL10	CL7	22	0.1094	.574	
3	CL4	CL5	39	0.1328	.442	
2	CL3	CL13	42	0.1749	.267	
1	CL2	ad-6	43	0.2667	.000	

Proplind	Prop	Plind	pH	Carbono	Fosforo	Aluminio	CIC	Prin1	Prin2	Prin3	Prin4	Prin5
a-8	a	8	5.30	13.00	6.70	1.80	5.62	1.43002	-0.02645	1.54794	-0.59307	1.64657
b-6	b	6	5.40	7.52	4.00	2.20	6.90	0.54659	0.49622	-0.10285	1.04482	0.01503
c-9	c	9	5.50	11.60	3.30	1.40	4.84	0.82272	-0.66397	1.29643	0.55931	0.24958
d-6	d	6	5.40	7.00	6.00	1.80	5.19	0.63839	0.16860	-0.66618	0.40380	1.72231
e-0	e	0	5.30	7.00	5.90	1.10	4.70	0.56665	-0.22042	-0.86638	-0.24235	1.46848
f-0	f	0	5.50	11.50	5.00	1.02	4.42	1.06977	-0.78544	0.87299	-0.05653	1.06865
g-6	g	6	6.20	6.23	4.60	1.20	4.85	0.92847	-0.68449	-1.36984	2.31550	1.01898
h-6	h	6	5.05	8.84	1.78	0.80	2.49	-0.28388	-1.10912	0.56695	-0.22604	0.44165
i-6	i	6	4.85	10.87	2.20	1.30	4.40	0.05201	-0.48802	1.47681	-0.70378	-0.21400
j-6	j	6	5.46	6.50	1.18	0.50	2.45	-0.32867	-1.38141	-0.55922	0.92260	0.11379
k-6	k	6	5.10	5.70	9.00	3.22	8.66	1.00948	2.01600	-1.06826	-0.01537	2.09814
l-6	l	6	4.90	2.00	2.15	0.77	3.70	-0.98406	-0.33738	-2.11137	-0.01962	0.04057
m-9	m	9	4.60	5.47	2.00	1.40	7.21	-0.46296	0.56908	-0.55546	-0.68120	-1.78597
n-0	n	0	5.10	6.00	3.80	0.94	5.97	0.14419	-0.05165	-0.98071	-0.24515	-0.41104
o-0	o	0	5.15	5.00	1.60	0.70	2.96	-0.62150	-0.88747	-0.99095	0.36357	0.13076
p-6	p	6	3.90	0.50	0.69	1.87	3.16	-2.29567	0.61321	-1.49873	-1.19382	0.20837
q-0	q	0	5.15	5.50	0.61	0.70	1.66	-0.87631	-1.24990	-0.57974	0.55744	0.38724
r-8	r	8	5.10	6.20	3.18	2.39	6.02	-0.08050	0.60063	-0.21264	0.78739	0.22196
s-8	s	8	5.00	6.30	1.40	2.50	5.00	-0.55710	0.36145	0.24041	1.03332	-0.00517
t-9	t	9	4.70	7.00	3.90	2.00	4.64	-0.28662	0.36816	0.09606	-0.62925	1.00747

u-11	u	11	5.30	9.24	3.00	0.50	3.55	0.29631	-1.11351	0.23412	-0.15861	0.26446
v-6	v	6	4.50	8.60	2.00	0.90	2.60	-0.67180	-0.70888	0.74336	-1.48745	0.44525
w-9	w	9	4.40	7.50	2.50	1.80	4.80	-0.62504	0.31777	0.54645	-1.19009	0.02585
x-6	x	6	5.00	9.00	1.00	4.30	5.64	-0.42129	1.15348	2.04369	1.98008	0.56643
y-9	y	9	5.20	8.50	2.27	0.73	3.04	-0.06402	-1.05679	0.23189	-0.00224	0.35494
z-0	z	0	4.80	4.30	3.20	1.35	4.16	-0.62852	0.02356	-1.12395	-0.36683	0.59656
aa-8	aa	8	5.00	7.00	1.70	0.99	4.98	-0.26766	-0.39846	-0.16299	-0.05262	-0.87358
ab-6	ab	6	5.30	9.00	3.00	0.60	3.49	0.25024	-1.06082	0.18736	-0.07137	0.37184
ac-8	ac	8	5.40	9.20	3.50	0.31	9.11	1.13431	-0.14839	-0.29815	-0.21802	-2.80908
ad-6	ad	6	5.70	11.20	14.20	0.50	14.66	3.92402	1.58623	-1.49496	-2.12281	-0.66493
ae-0	ae	0	5.40	8.20	0.82	0.77	5.69	0.13183	-0.73414	0.10095	0.82764	-1.80680
af-9	af	9	4.90	6.80	0.94	0.88	5.08	-0.45935	-0.42742	-0.13037	-0.16328	-1.39052
ag-0	ag	0	5.70	6.00	1.00	0.50	5.28	0.09929	-0.94939	-1.00034	1.54639	-1.54704
ah-0	ah	0	4.20	8.00	1.76	4.40	8.71	-0.63602	2.35054	1.80223	0.04608	-0.90928
ai-0	ai	0	4.50	8.20	3.50	3.00	6.67	-0.21663	1.24300	1.01080	-0.52317	0.23766
aj-6	aj	6	3.70	0.10	0.54	4.53	5.40	-2.52669	2.46033	-0.55431	0.05246	0.58744
ak-11	ak	11	5.30	7.00	4.00	0.90	4.50	0.26397	-0.51017	-0.65755	0.07276	0.52511
al-6	al	6	5.60	7.00	3.70	4.00	11.30	0.91998	2.11937	0.14460	2.71539	-1.41625
am-11	am	11	4.70	9.00	0.68	2.08	3.46	-0.71242	-0.21006	1.43650	-0.02083	0.12516
an-9	an	9	4.50	7.10	3.30	0.99	5.82	-0.26289	0.15619	-0.16759	-1.61948	-0.68454
ao-9	ao	9	5.00	11.00	2.00	1.00	4.20	0.15210	-0.77813	1.37031	-0.50303	-0.36876
ap-6	ap	6	4.50	7.10	3.30	0.99	5.82	-0.26289	0.15619	-0.16759	-1.61948	-0.68454
aq-3	aq	3	5.00	11.00	2.00	1.00	4.20	0.15210	-0.77813	1.37031	-0.50303	-0.36876

--- CLUSTER=1 ---

Proplind	CLUSNAME
ac-8	CL5
ah-0	CL5
ai-0	CL5
ak-11	CL5
al-6	CL5
an-9	CL5
ap-6	CL5
b-6	CL5
d-6	CL5
e-0	CL5
g-6	CL5
k-6	CL5
m-9	CL5
n-0	CL5
r-8	CL5
t-9	CL5
x-6	CL5

--- CLUSTER=2 ---

Proplind	CLUSNAME
a-8	CL4
aa-8	CL4
ab-6	CL4
ae-0	CL4
af-9	CL4
ag-0	CL4
am-11	CL4
ao-9	CL4
aq-3	CL4
c-9	CL4
f-0	CL4
h-6	CL4
i-6	CL4
j-6	CL4
o-0	CL4
q-0	CL4
s-8	CL4
u-11	CL4
v-6	CL4
w-9	CL4

y-9	CL4
z-0	CL4

--- CLUSTER=3 --

Proplind	CLUSNAME
aj-6	CL13
l-6	CL13
p-6	CL13

--- CLUSTER=4 --

Proplind	CLUSNAME
ad-6	ad-6

Lebenslauf

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