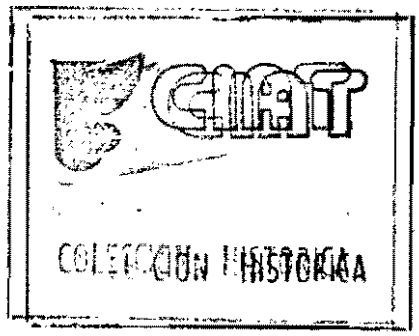


CIAT

HILLSIDE AGROECOSYSTEM:

ANDEAN REGION

RIO OVEJAS WATERSHED

TABLE OF CONTENTS

MULTIPLE STAKEHOLDER ORGANIZATION

"CIPASLA"

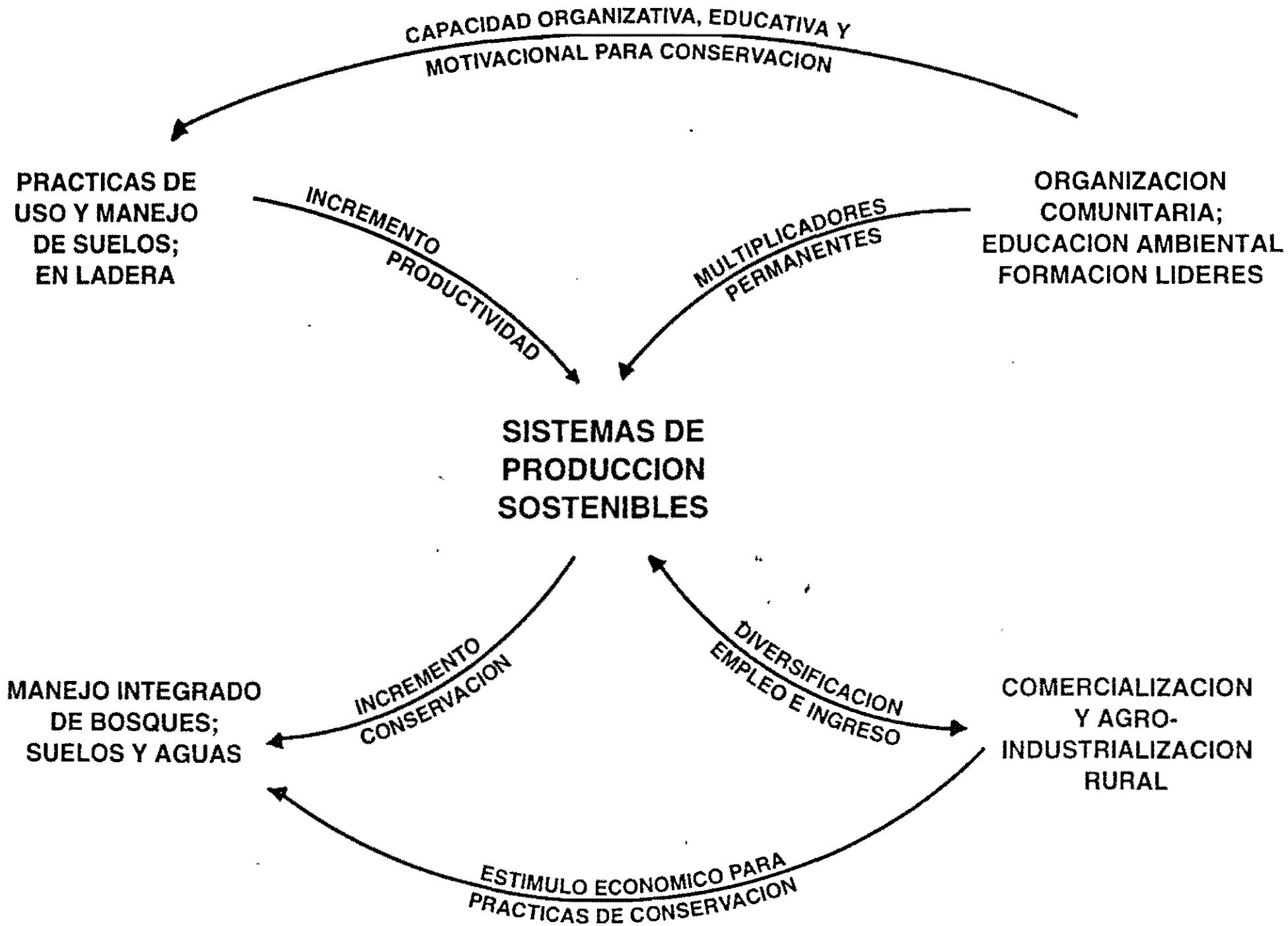
CONSORCIO INTERINSTITUCIONAL PARA UNA AGRICULTURA SOSTENIBLE EN LADERAS

JAA-PanField.wp

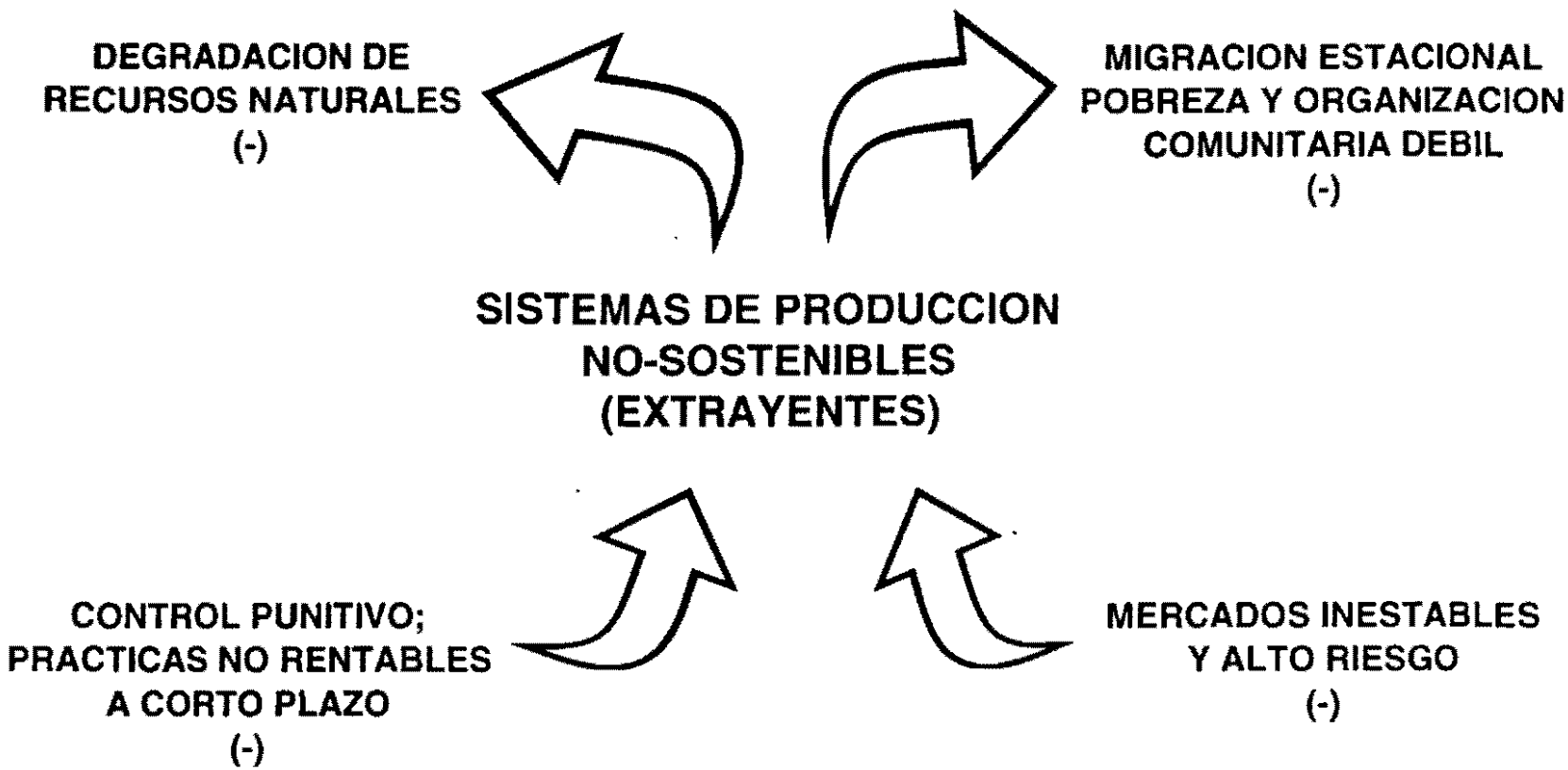
HILLSIDES AGROECOSYSTEM: DECISION SUPPORT FOR COMMUNITY-BASED R&D

SCALE				CIAT PROJECT
Field	Is this field degraded? (composite indicators)	Is this field at risk of being degraded? (early warning indicators)	What is the on-site cost of degradation in this field?	SOIL QUALITY ASSESSMENT
	How can the "quality" of this field be sustained?		What is the on-site cost of conservation/regeneration of the field?	COMPONENT GERMPLASM & INTEGRATED CROP MGT.
Land use type (enterprise)		What are viable options for changing the land use?		PROTOTYPE SYSTEMS
FARM	Can the farm survive with a given portfolio of enterprises and incentives?		What is the impact on a given class of stakeholders (farmers)? Are they at risk?	DECISION SUPPORT
				PARTICIPATORY RESEARCH
WATERSHED	What are the aggregate consequences of degradation: where are the "at risk" areas?		What is the impact on the watershed community?	LAND USE REGIONAL & POLICY ANALYSIS
OFF-SITE	What are the consequences of degradation off-site? (Is this a "strategic" watershed?)		Are there transferable costs?	

PROPOSITO DE CIPASLA



SITUACION DE LA AGRICULTURA NO-SOSTENIBLE EN LADERAS



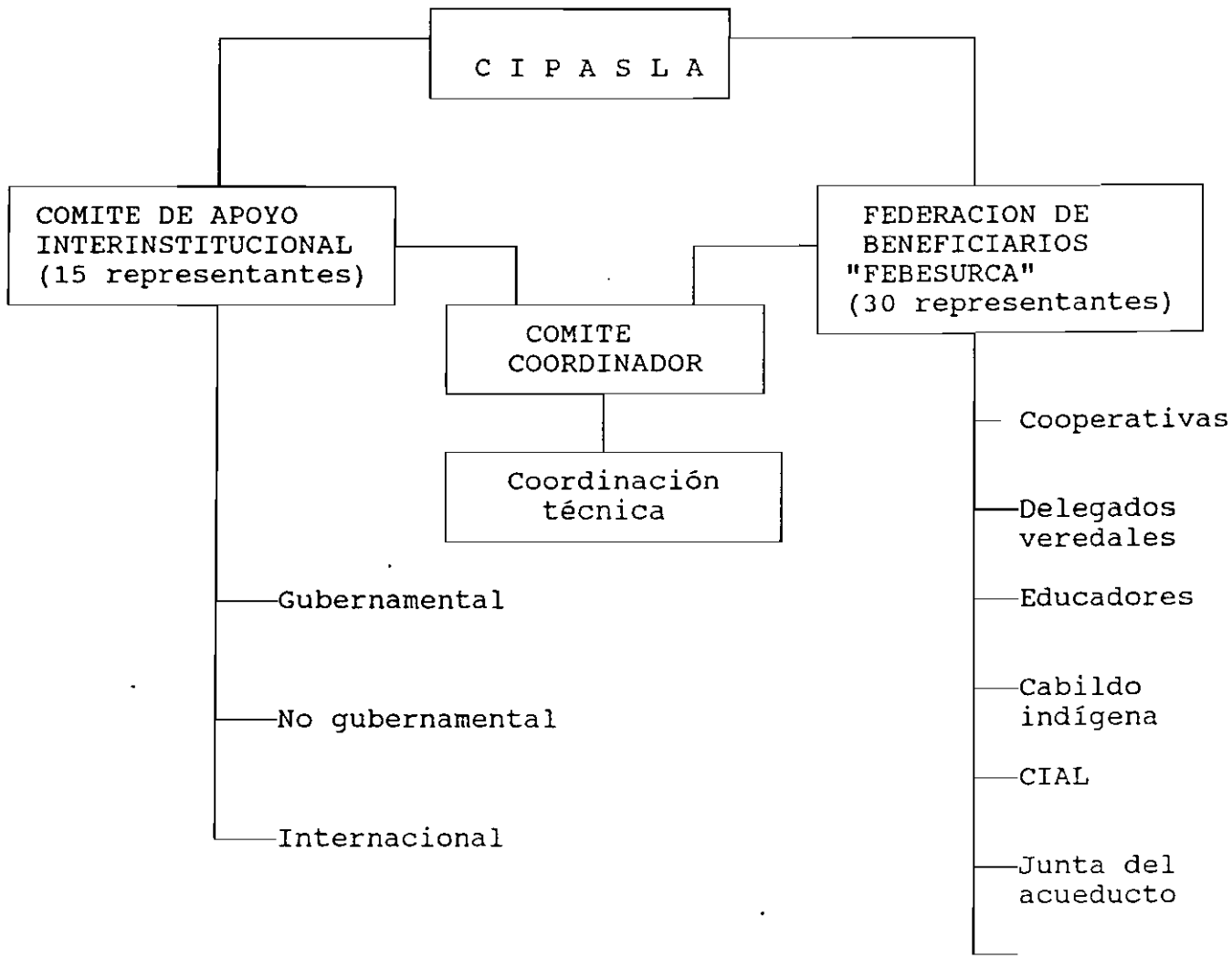
PROCESO ORGANIZATIVO CIPASLA

Nov. 92:	Taller de planeación (18 entidades)
Dic. 92-Feb. 93:	Selección del área - Organigrama
Mar. 93:	Taller PPO (9 entidades)
Abr.-Jul. 93:	Normas y funciones de los comités Formulación de proyectos Cofinanciación de los proyectos
Ago. 93:	Taller: "Metodología de trabajo" Diagnóstico
Sep. 93:	Inicio de proyectos Ejecución de Encuesta
Oct. 93:	Firma Convenio-Marco Definición manejo de recursos (modelo FIDUCIA) Plan de concertación con agricultores
Ene. 94:	1er Taller de evaluación CIPASLA
Feb.-Dic. 94:	Ejecución de proyectos Inclusión nuevas entidades (15)
Ene. 95	2o. Taller de evaluación CIPASLA
Agosto. 95:	Actualización plan estrategico

PROCESO ORGANIZATIVO "FEBESURCA"

ENE-ABR 94	-	PASOS PARA APROBACION DE PROYECTOS
	-	REGLAMENTACION DE ESTATUTOS
	-	MANEJO DE FONDOS PERMANENTES (MODELO FIDUFES)
	-	METODOLOGIA PARA FORMULAR Y EVALUAR PROYECTOS
	-	CONFORMACION COMITE EVALUADOR DE PROYECTOS
	-	PERSONERIA JURIDICA ASOCIACION
MAY. 94	-	APROBACION DE PROYECTOS
JUL.-DIC. 94	-	ELECCION NUEVA JUNTA
	-	"FEBESURCA"
	-	ORGANIZACION DE ACTIVIDADES PARA PROYECTOS
ENE. 95	-	INTEGRACION DE PROYECTOS COMUNITARIOS CON LOS INSTITUCIONALES

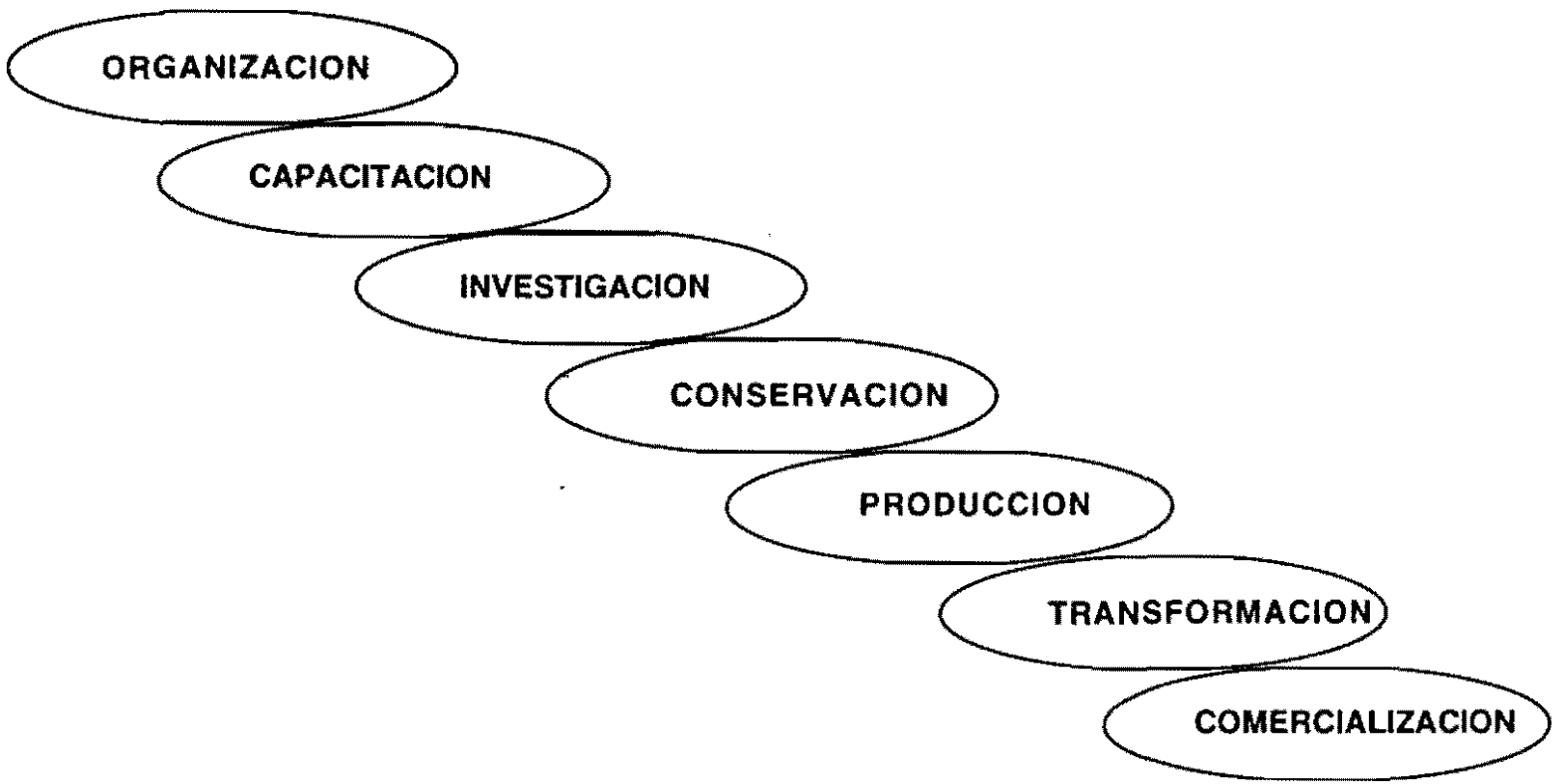
ORGANIGRAMA CIPASLA



JUNIO 1995

GUBERNAMENTALES:	CRC SENA INAT SECRETARIA DE AGRICULTURA UMATA Caldono CVC
NO GUBERNAMENTALES:	FIDAR CETEC COMITE DE CAFETEROS CORPOTUNIA SOL Y TIERRA CORPORENORDE
INTERNACIONAL:	CIAT
COMUNITARIO:	FEBESURCA

CADENA LOGICA DE LA SOSTENIBILIDAD



RELACION DE OBJETIVOS CIPASLA CON LOS PROYECTOS EN EJECUCION

OBJETIVOS	PROYECTOS EN EJECUCION
1. Autogestión de recursos por las comunidades	* Desarrollo artesanal * Identificación del estado de los proyectos de subsidio para saneamiento básico
2. Adopción de prácticas de cobertura vegetal para regulación hidrológica	* Manejo integral de los recursos naturales a microcuencas con influencia en acueductos veredales * Reforestación con bambú
3. Adopción de alternativas tecnológicas que incrementan la productividad	* Tecnologías orgánicas para el manejo de la fertilidad del suelo * Mejoramiento del uso de energía animal en preparación, prácticas culturales y cosecha en suelos de ladera * CIAL * Aporte de N con leguminosas a cultivos posteriores
4. Alternativas de produccion para reducir talas	* Desarrollo de sistemas de producción para ecosistemas de laderas

RELACION DE OBJETIVOS CIPASLA CON LOS PROYECTOS EN EJECUCION
(continuación)

OBJETIVOS	PROYECTOS EN EJECUCION
5. Adopción de prácticas de uso y manejo del suelo	* Efectos de la degradación y prácticas de conservación del suelo sobre la productividad * Conservación de suelos mediante el manejo de cultivos de ladera * Establecimiento de barreras vivas con participación de agricultores
7. Aumentar la eficiencia de los canales de comercialización	* Establecimiento de agroindustrias rurales
8. Ejecutar programas de educación ambiental	* Investigación participativa y diseño educativo sobre cultura y medio ambiente * Reconocimiento y análisis de recursos naturales en comunidades rurales
9. Identificación de la problemática ambiental y socio-económica	* Diagnóstico participativo * Recolección información cuantitativa * SIG (Sistema de información geográfica) * Estudio macrofauna del suelo * Caracterización de niveles de bienestar

PROYECTO: MANEJO INTEGRAL DE LOS RECURSOS NATURALES

EJECUTOR: C.V.C.
COLABORADORES: CRC, SENA, UMATA, CORPOTUNIA, FEBESURCA.

"AISLAMIENTOS - 1993B-1995A"

SITIOS	Area aislada (metros)	Area en proceso (metros)	Agricultores participantes
Buenavista, Cidral, El Oriente, La Esperanza, Porvenir, Rosario y Ventanas.	21.000 = 62.5 ha.	23.500 = 70.0 ha	1.600

PROYECTO: MANEJO INTEGRAL DE LOS RECURSOS NATURALES

EJECUTOR: C.V.C.
Colaboradores: CRC, FEBESURCA, SENA, UMATA, CORPOTUNIA

"SIEMBRA DE ARBOLES - 1994-1995"

SITIOS	Ornamen-tales	Maderables nativos	Energético	Frutales	Agricultores participan-tes	TOTAL
Buenavista, Caimito, Cabuyal, Cidral, El Oriente, La Esperanza, Los Quingos, Palermo, Panamericana, Pescador, Primavera, Santa Barbara, Socorro, Ventanas.	4.700	27.000	52.000	1.000	400	84700 = 70 ha

RELACION DE PROYECTOS CON LA CADENA LOGICA DE LA SOSTENIBILIDAD

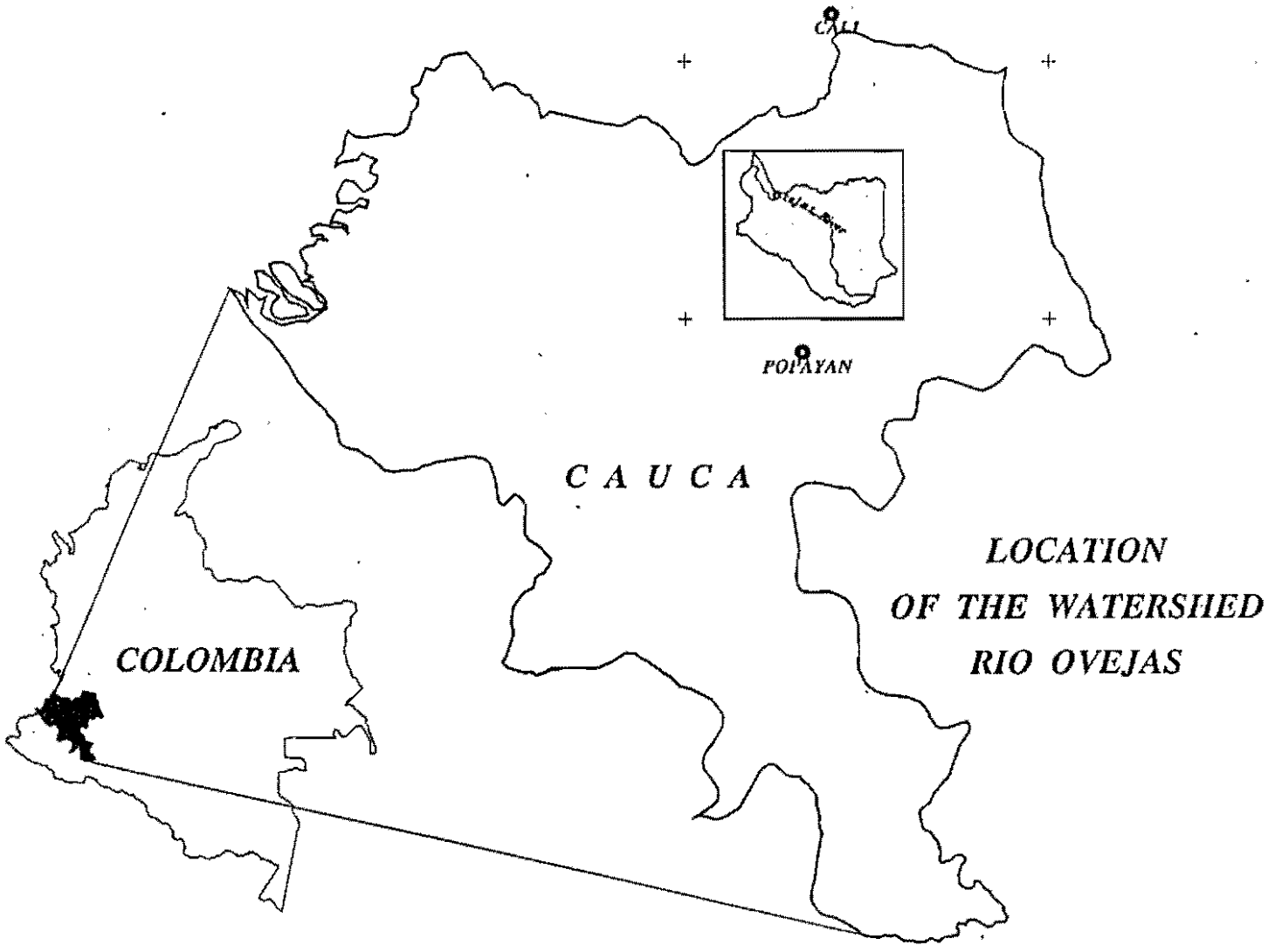
Objetivo CIPASLA	Organi-zación	Conser-vación	Produc-ción	Investigación	Transfor-mación	Comer-cializa-ción	Capaci-tación
Autogestión de recursos por comunidades	✓ (ONG) ✓ (ONG)		✓ (ONG)	✓ (ONG)			
Adopción prácticas de cobertura para regulación hídrica	✓ (OG)	✓ (OG) ✓ (ONG)	✓ (ONG)				✓ (OG) ✓ (ONG)
Alternativas tecnológicas que incrementan producción	✓ (ONG) ✓ (IPRA)	✓ (ONG) ✓ (IPRA)	✓ (IPRA)	✓ CIAT/ONG) ✓ (ONG) ✓ (IPRA)			✓ (ONG) ✓ (IPRA)
Sistemas de producción para reducir talas				✓ Inter-program (CIAT)			
Prácticas de uso y manejo del suelo	✓ (OG) ✓ (IPRA)	✓ (IPRA)		✓ (CIAT)			✓ (OG)
Riego en ladera							
Canales de comercialización	✓ (ONG)				✓ (ONG)		✓ (ONG)
Educación ambiental	✓ (ONG) ✓ (ONG)	✓ (OG)		✓ (ONG) ✓ (ONG)			✓ (ONG/OG)
Identificación de la problemática ambiental y socioeconómica				✓ (CIAT) ✓, ✓, (IPRA) ✓, ✓			

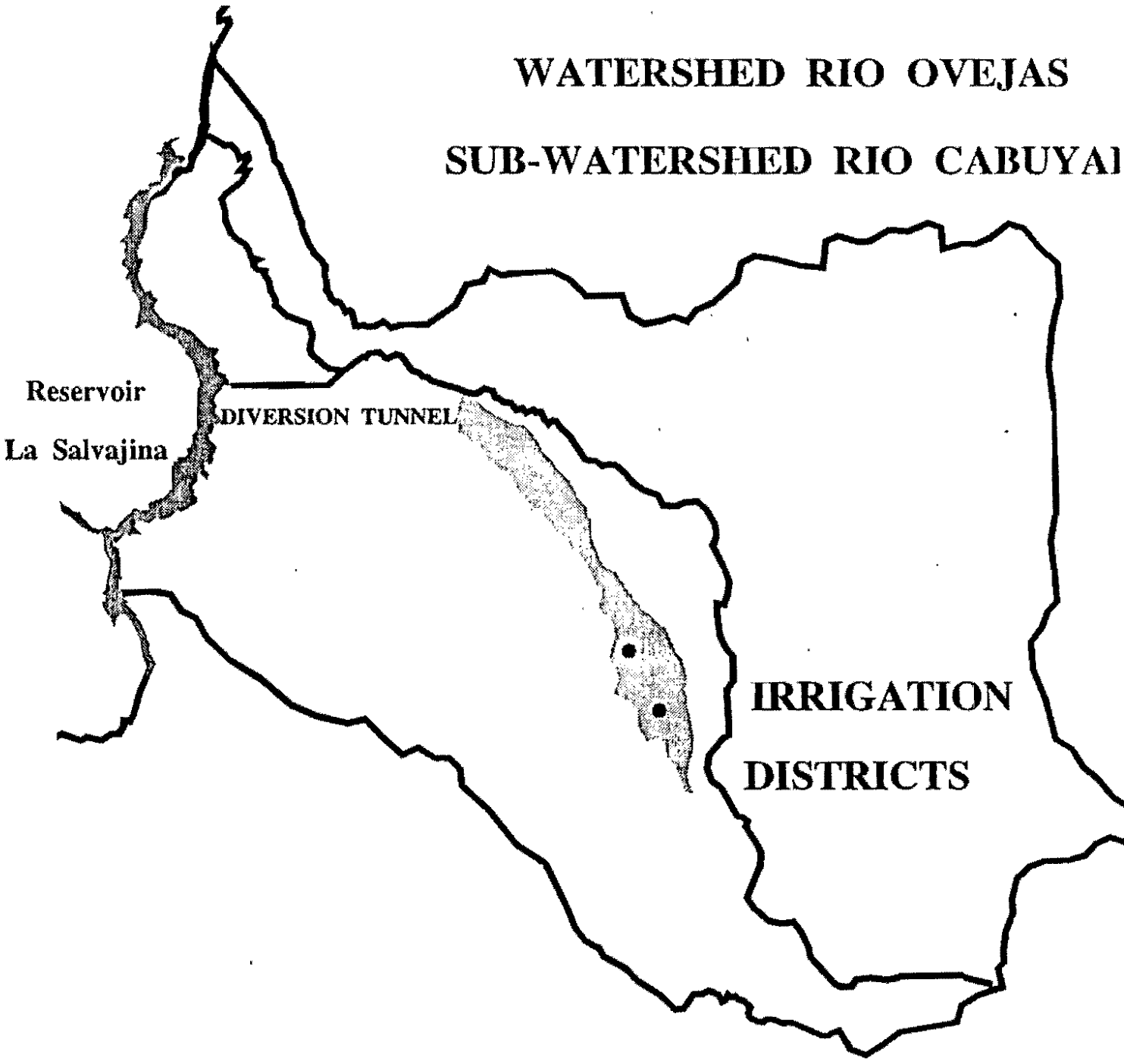
PRESUPUESTO CIPASLA 1994-1995

	CIID	DRI	CIAT	ENTI-DADES	COMU-NIDADES	TOTAL
Capacitación		10.0	10.0	42.0	10.3	112.9
Organización	40.6	10.0	10.0	12.0	7.3	79.9
Investigación	40.6		78.0	78.0	15.6	171.6
Conservación		20.0	20.0	30.0	56.0	126.0
Asistencia Técnica/ producción agropecuaria				38.0	3.8	41.8
Comercialización, transformación				4.0	3.8	7.8
TOTAL	81.2	40.0	118.0	204.0	96.8	540.0

RIO OVEJAS WATERSHED

JAA-PanField.wp


CALI
POPAYAN
CAUCA
COLOMBIA
LOCATION
OF THE WATERSHED
RIO OVEJAS


WATERSHED RIO OVEJAS
SUB-WATERSHED RIO CABUYAI
Reservoir
La Salvajina
DIVERSION TUNNEL
IRRIGATION
DISTRICTS

RIO OVEJAS
CAUDALES PARA EL RIO OVEJAS
(FLOW RATE)

YEAR	FLOW RATE (m^3/sec)
1982	32.4
1983	24.2
1984	36.5
1985	26.6
1986	26.7
1987	18.7
1988	24.6
1989	24.5
1990	25.3
1991	19.5
1992	15.0

JAA-PanField.wp

MAP 4

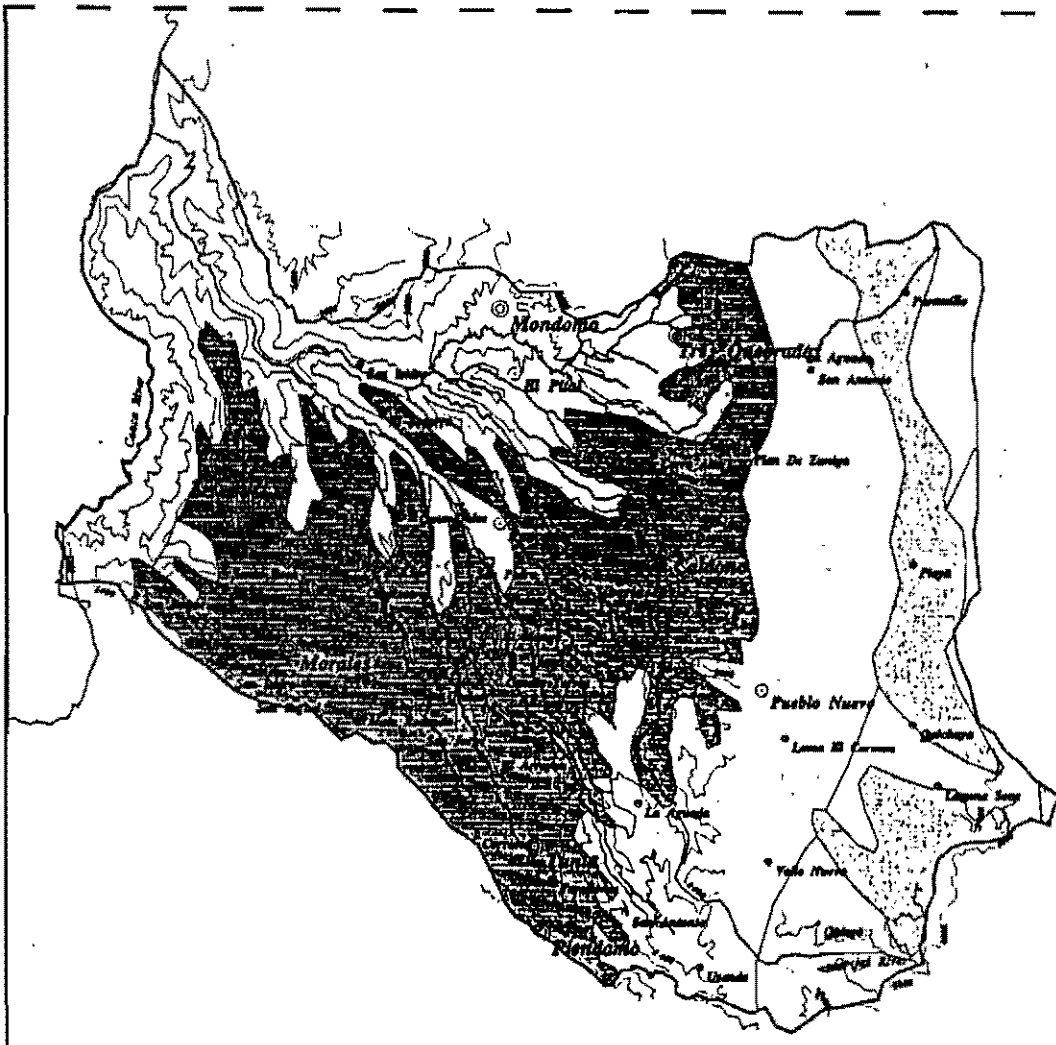
EROSION IN OVEJAS RIVER WATERSHED

LEGEND

- WITHOUT EROSION
- SLIGHT
- MODERATE
- SEVERE
- VERY SEVERE

CIAT
Land Use Program
August 1993

MAP 5



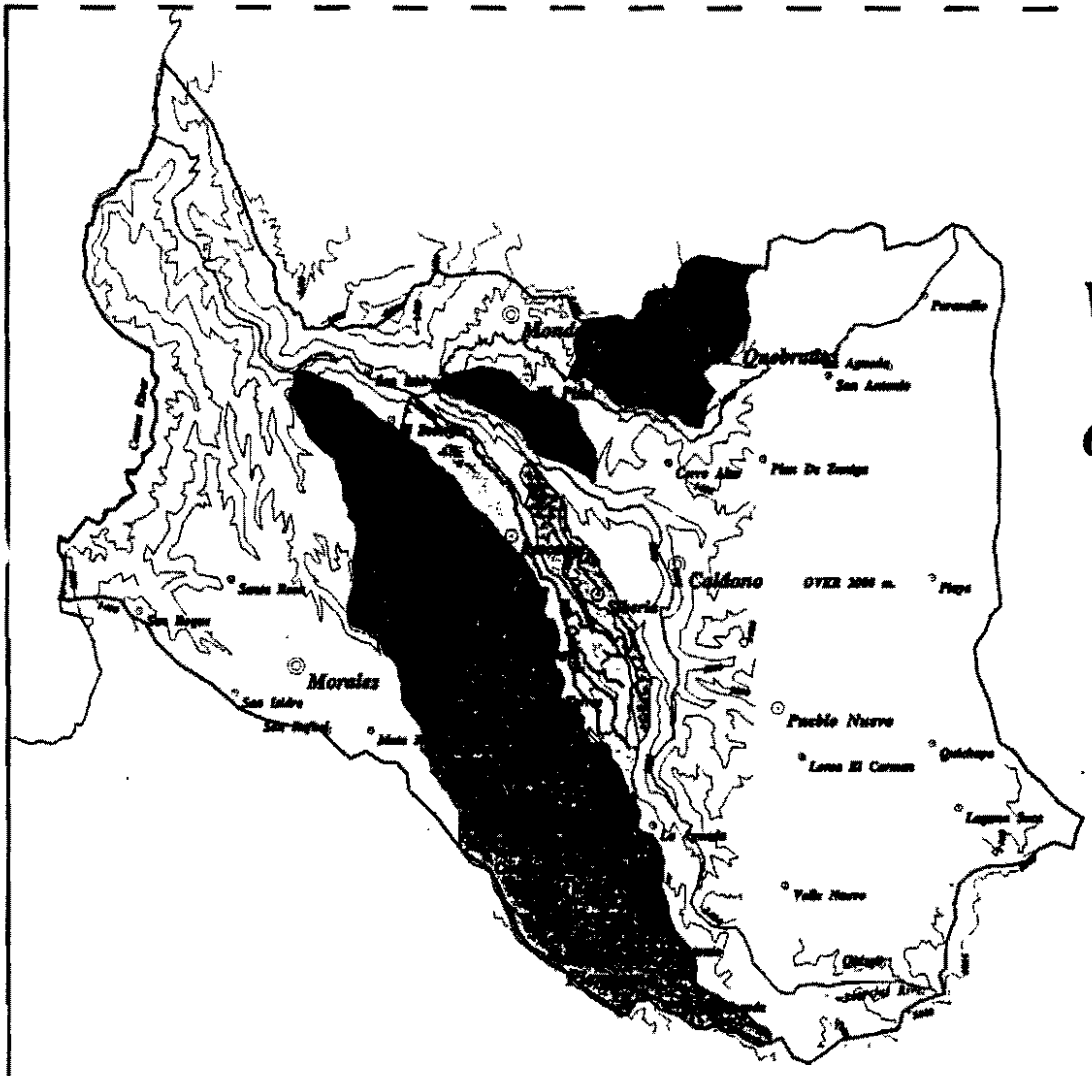
CLIMATIC ZONES OF OVEJAS WATERSHED

LEGEND

- Bleak Plateau
- Very cold/humid
- Moderatly cold/Very humid
- Mild/Very humid
- Moderatly hot/Very humid
- Hot/Sub-humid

CIAT
Land Use Program
August 1993

MAP 6



MICRO - WATERSHEDS OF THE OVEJAS RIVER

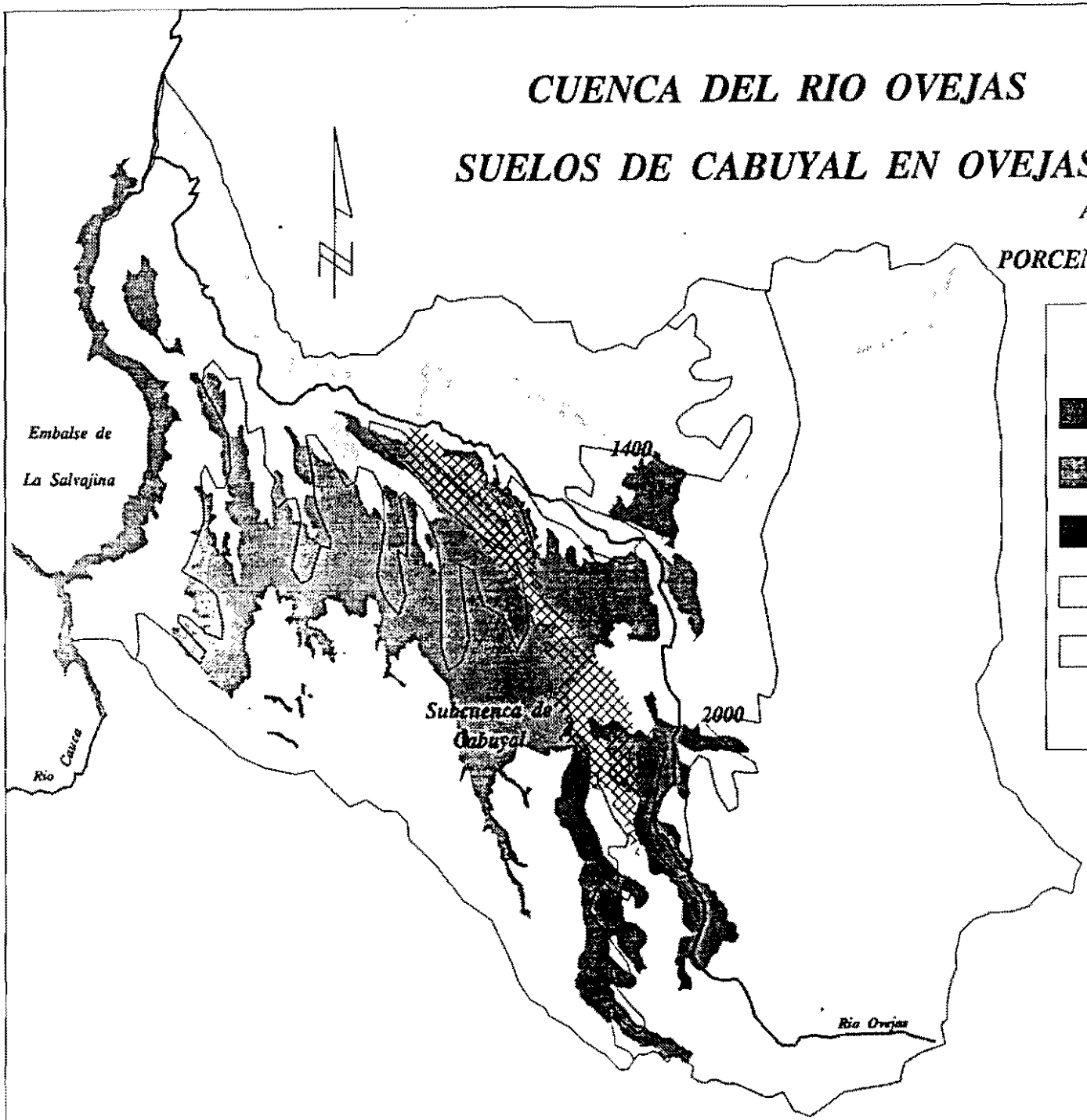
LEGEND

- *Q. Tres Quebradas*
- *Q. Las Lajas*
- *Rio Pescador*
- *Rio Cabuyal*
- *Q. Guaicoche*

C I A T
Land Use Program
August 1993

CUENCA DEL RIO OVEJAS

SUELOS DE CABUYAL EN OVEJAS



ASOCIACIONES DE SUELOS

PORCENTAJE CON RESPECTO AL TOTAL

	OVEJAS	OVEJAS <2000
FARALLONES	4.5	3.8
PESCADOR	15.2	24.6
PUELENGE	0.1	0.3
SUAREZ	11.1	17.9
USENDA	14.5	5.4
TOTAL	45.4	51.9

ESCALA 1:250.000

Main land use at the Cabuyal Watershed in Cauca, Colombia (Area in Plazas, 1 Plaza = 0.64 ha)
Total area over plots

	Zone								
	High			Medium			Low		
	Total Area (Plazas)	Area %	Plots	Total Area (Plazas)	Area %	Plots	Total Area (Plazas)	Area %	Plots
Coffee	528.1	60.4	365	688.0	59.5	481	484.3	44.4	414
Cassava	155.3	17.8	161	245.7	21.2	212	336.2	30.8	258
Maize	31.1	3.5	38	18.5	1.6	24	24.4	2.2	44
Beans	49.7	5.7	51	62.6	5.4	54	21.2	2.0	17
Other	109.8	12.6	131	141.8	12.3	165	224.0	20.6	212
Total	874.0	100.0	746	1156.6	100.0	936	1090.1	100.0	945

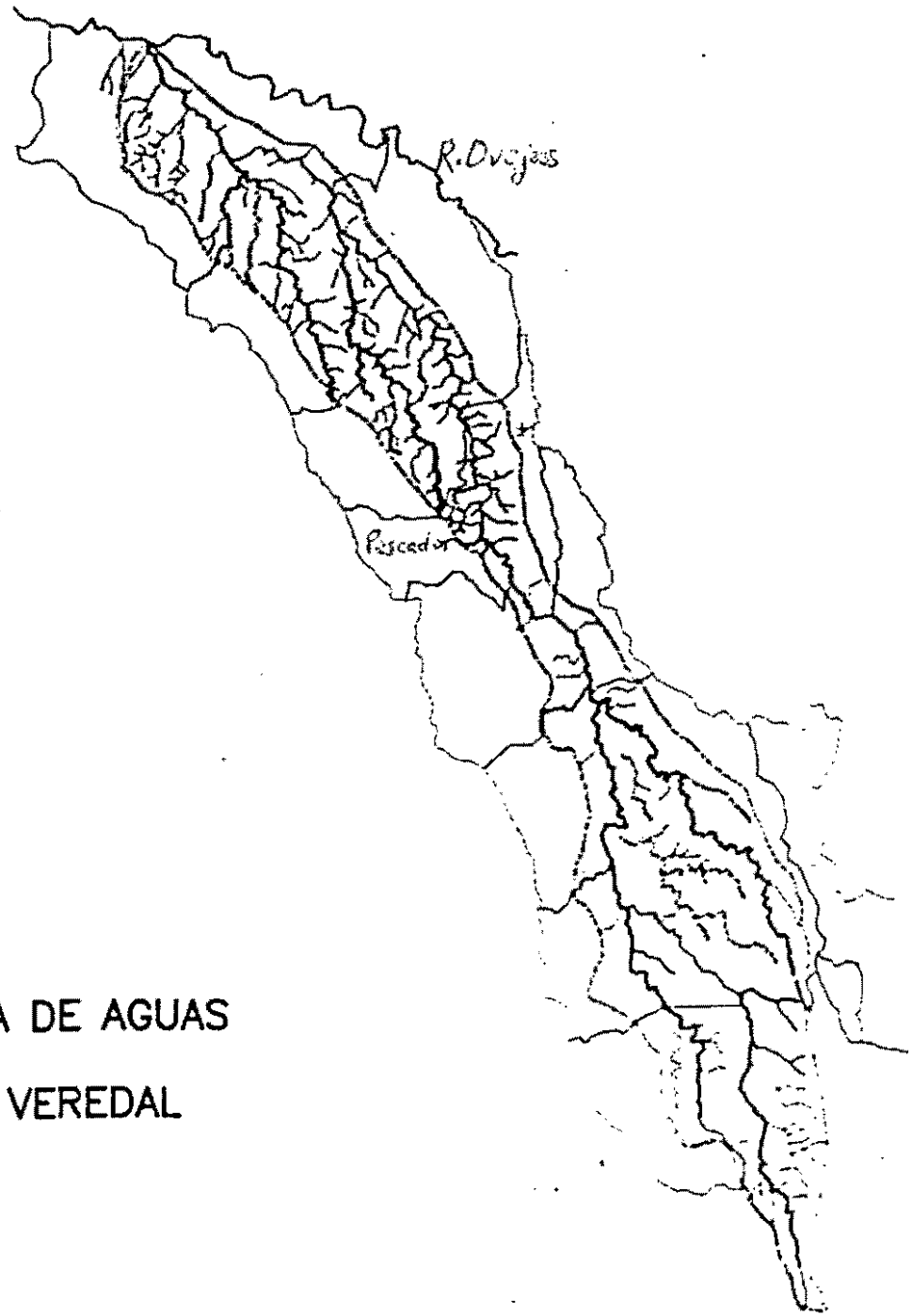
Source: Cabuyal watershed census 1993-1994

Land use at the Cabuyal Watershed in Cauca, Colombia (Area in Plazas, 1 Plaza = 0.64 ha)
Total area over farms

		Zone								
		High			Medium			Low		
		Total Area (Plazas)	Area %	Farms	Total Area (Plazas)	Area %	Farms	Total Area (Plazas)	Area %	Farms
Pastures	Sown	42.8	2.28	48	115.3	6.11	83	113.5	7.71	83
	Native	345.1	18.38	129	265.7	14.08	176	215.4	14.63	147
Forest	Sown	106.8	5.69	28	10.7	0.57	15	15.7	1.07	21
	Native	155.1	8.26	93	188.7	10.00	165	144.3	9.80	133
Fallow		630.9	33.60	213	494.7	26.21	259	340.6	23.13	206
Crops		597.0	31.79	351	809.0	42.87	437	642.9	43.66	385
Total		1877.7	100.0	862	1887.1	100.0	1135	1472.4	100.0	975

Source: Cabuyal watershed census 1993-1994

RIO CABUYAL CATCHMENT



Principales

Secundarios

Terciarios

TIPO DE RIO

DIVISORIA DE AGUAS

DIVISION VEREDAL

RIOS DE LA SUBCUENCA

BASE CARTOGRAFICA IGAC ESCALA 1:10.000

3. DSSAT v3 (Tsuji et al., 1994)

4. ArcView 2.0 (ESRI, 1994)

AEGIS+ Requirements (See Luyten et al., 1994, for details)

HARDWARE:

1. SUN SPARC workstation

2. Disk with over 30 MB of free space. The required disk space increases considerably when new coverages and weather files are added.

SOFTWARE:

1. SUN OS version 4.1 or higher

2. OpenWindows version 3.0 or higher

3. ARC/INFO version 6.1 or higher (Esri, 1991)

4. DSSAT v3 crop models (Hoogenboom et al., 1994), recompiled to run under the SUN workstation.

4.0 CURRENT APPLICATIONS OF AEGIS

4.1 Using AEGIS to Evaluate the Feasibility of Small Irrigation Projects for Watersheds in the Andes of Colombia

In lesser developed countries, there is a general need to identify data efficient, objective and comprehensible regional land use planning tools to support multi-party negotiation and consensus building. This study tested the AEGIS+ v2.0 modeling software for its appropriateness in assessing the potential effects of small irrigation projects on the regional water balance within a small mountain catchment in southwestern Colombia (Figure 2). Conflicting goals of within-watershed and offsite water demands are likely to become increasingly contentious issues as societies attempt to keep pace with the food and water demands of ever increasing populations.

The specific region chosen for this proof-of-concept analysis is the 3,200 ha Rio Cabuyal sub-catchment nested within the 100,000 ha Río Ovejas watershed. Certain critical assumptions were made which affect the reliability and acceptance of the analysis. A common problem in developing countries is the paucity of reliable, long term climate data. No climate station exists within the Rio Cabuyal sub-catchment although several stations lie within a close radius. Consequently, long term daily weather sequences were generated using the Weatherman routine available with DSSAT v.3 and AEGIS (Pickering et al., 1994), and interpolated using an inverse square function.

Soil properties are important parameters in all production-based simulation models. Model parameters for the four soil mapping units in the sub-catchment, all classified as Andisols, were taken from previously published soil surveys, an historical database of more than 1,000 samples made available from the state agricultural department, and corroborating field measurements.

Hillside environments are characterized by variable topography which may severely limit crop management decisions like machinery use and irrigation options. A digital terrain model was created from existing 1:10,000 topographic maps using ARC/INFO which allowed for the interactive selection of slope class intervals. For the analyses presented, three class intervals were chosen: 0<7%, 7<30% and > 30% slopes. The potential for irrigation was restricted to the 0<7% slope class within the watershed.

Sub-catchments within the Río Ovejas watershed, e.g., Rio Cabuyal, are ungaged so no systematic data were available. Field estimates at an upper, mid, and lower location in the Río Cabuyal were made using accepted, empirical, cost-effective field procedures.

For this study, production estimates and economic yield predictions were of secondary importance to water balance calculations. As such, drybean (Phaseolus vulgaris) was chosen as a proxy for a variety of higher value, short season, shallow rooted, row crops. Assumptions of lesser importance for the conclusions of the study relate to choice of variety, seeding and fertilization rates, residue management and non-limiting pest and disease control. In a typical environment of negotiation and consensus building, the analysis could be broadened by taking full advantage of crops and management practices including irrigation method and automatic irrigation scheduling strategies which are relevant to this analysis.

An important advantage of the GIS link provided by AEGIS is the capability to accurately and interactively define geographic space and access data directly from maps and images. Overlaying climate, soil and slope coverages resulted in the creation and definition of 993 polygons or "fields" within the 3,200 ha Río Cabuyal sub-catchment. The area of noncontiguous "fields" varied from less than 500 m^2 to several hectares. Some of this area, however, is roadway, homestead and watercourse and can be "de-selected" as never being available for agriculture.

During an interactive, compromise planning exercise, stakeholders can define conditions and select fields for inclusion in one or more planned irrigation projects. The tradeoffs in terms of

water partitioning for domestic reserves, irrigation demand and downstream use and concomitant temporal variability can then be assessed using AEGIS. Figure 2 presents the thematic map of one of many possible initial plans which calls for irrigation for all fields that meet the slope condition of 0<7% as an example where operational costs are important and irrigation would have to be gravity fed rather than pumped to the farmgate.

Figure 3 presents summary output of seasonal demand for irrigation by month of seeding for the predominant soil mapping unit. The box plots are based on AEGIS+ tabular output which summarizes seasonal minimum, average and maximum demand by "field" and by cropping strategy. Ten years of crop production were simulated for each month of seeding to obtain the variability shown in the figure. Irrigation demand is greatest for crops seeded in May because the main growing period for crops seeded in May are June, July and August, the driest months of the year. Irrigation demand is low for September seeding because October, November, and December have high rainfall amounts.

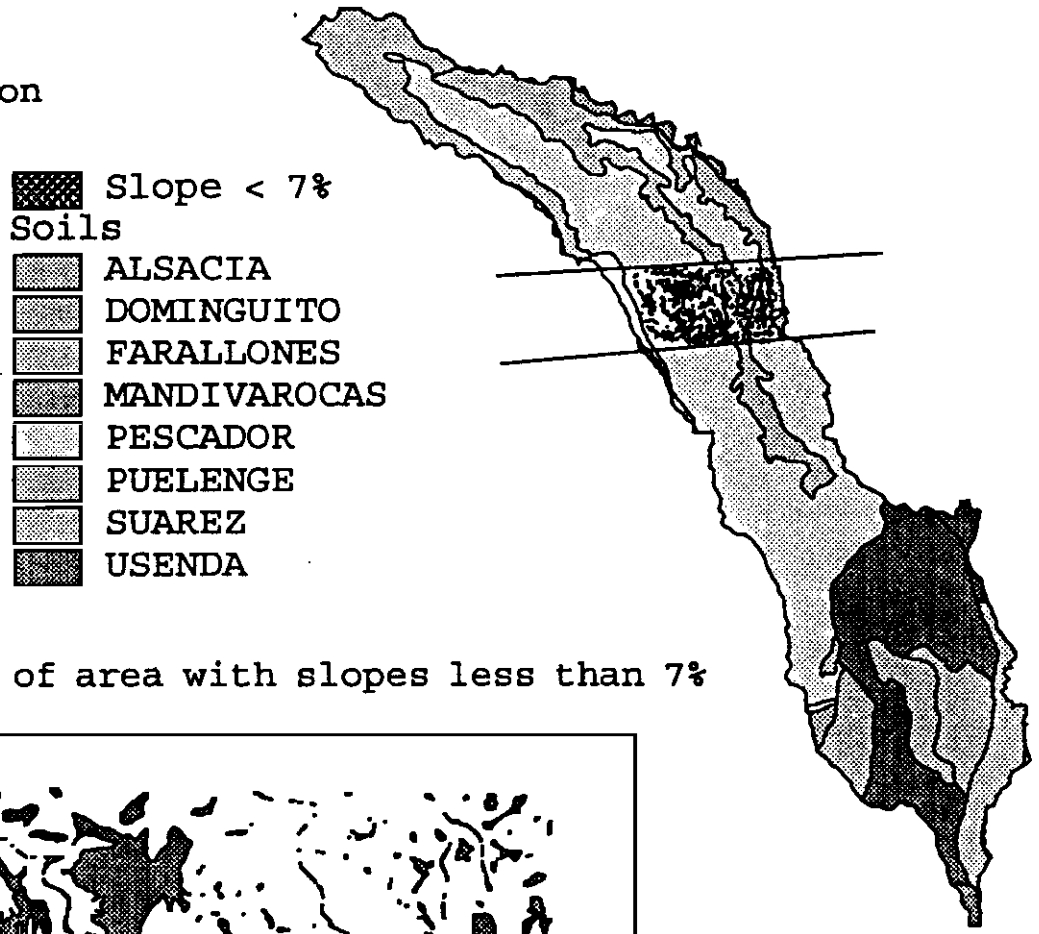
Figure 4 shows the expected percent reduction in river flow at two points (mid watershed and river mouth) for the one year out of ten in which irrigation demand was greatest, assuming that a total of 100 ha were irrigated. Percent reduction in river flow peaked in September when river flow was at its lowest and the maximum (one out of ten years) irrigation demand for September was a large percentage of that flow. This analysis quantifies risks and tradeoffs vis-a-vis multiple uses of water.

Using the approach outlined in this example, initial positions about resource planning can be quantified and presented for discussion. During discussions, new positions can be formulated and simulated in an iterative manner until a consensus is reached. AEGIS has been demonstrated to stakeholders in the region and they agree that data collection requirements are well within the capabilities of government agencies in most Latin American countries, and that the software might usefully and economically be applied for ex ante impact analysis and compromise planning addressing multiple objectives of land and water use.

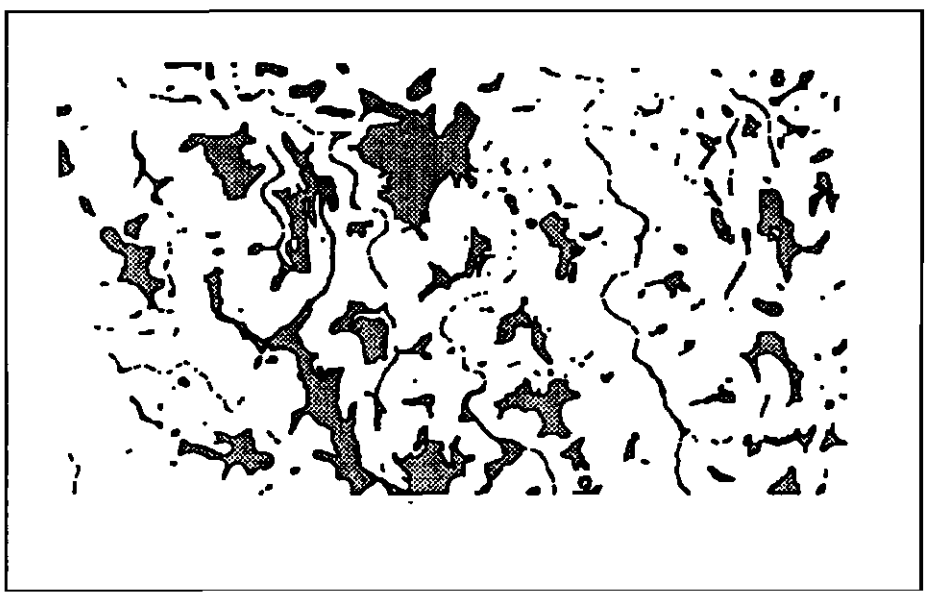
4.2 Assessing Agricultural Potential of Previous Sugarcane Land in Puerto Rico

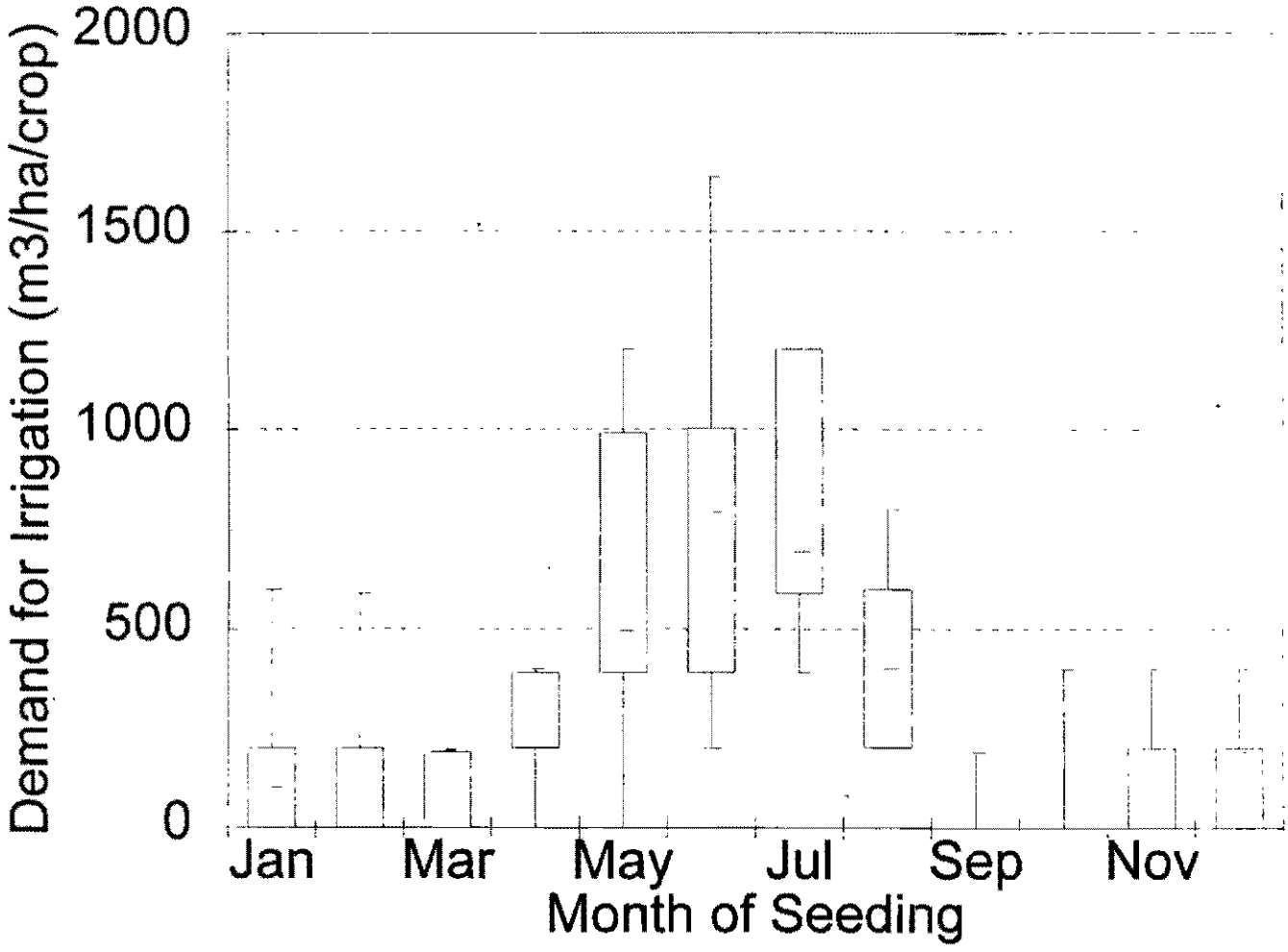
The south central coastal valley of Puerto Rico is one of the most fertile areas of the island which has been used in the past for sugarcane production. As a result of the depressed sugar market and the arrival of substitute sweeteners, sugarcane is no longer attractive to farmers of the region. Much of the land previously devoted to sugarcane is now idle and does not contribute to the economy of the island. Vegetable crops are now being grown in the valley. Growers use more inorganic fertilizers and pest control chemicals on these crops. Many of these lands are near rivers and the coast. Development of new types of agriculture on these lands could create create important economic activity for these areas, but it could also pose risks to surface and ground water quality. Agricultural planners and policy makers need to have information on the likely impacts of alternative agricultural uses of these lands previously devoted to sugar cane production. A project was initiated in 1992 to develop a study of one area in Puerto Rico to

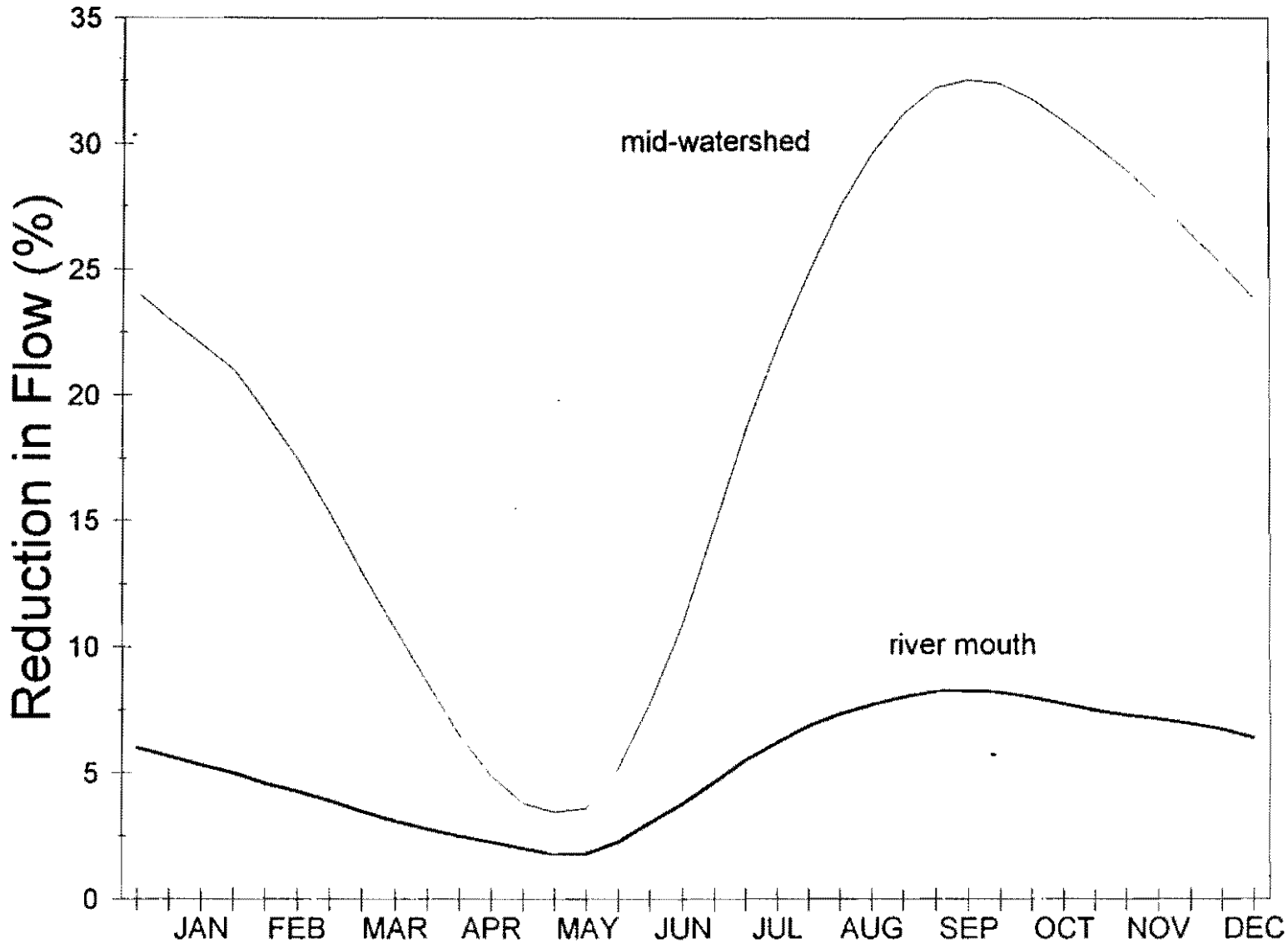
a. Soil Association



b. Expanded view of area with slopes less than 7%




Demand for Irrigation (m3/ha/crop)
2000
1500
1000
500
0
Jan
Mar
May
Jul
Sep
Nov
Month of Seeding


Reduction in Flow (%)
35
30
25
20
15
10
5
0
mid-watershed
river mouth
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

R. Vernooy

IN PRESS

IBSNAT BOOK - Chapter 14: **APPLICATION OF DSSAT TO THE EVALUATION OF LAND RESOURCES**

F.H. Beinroth, J.W. Jones, E. B. Knapp, P. Papajorgji, and J. Luyten

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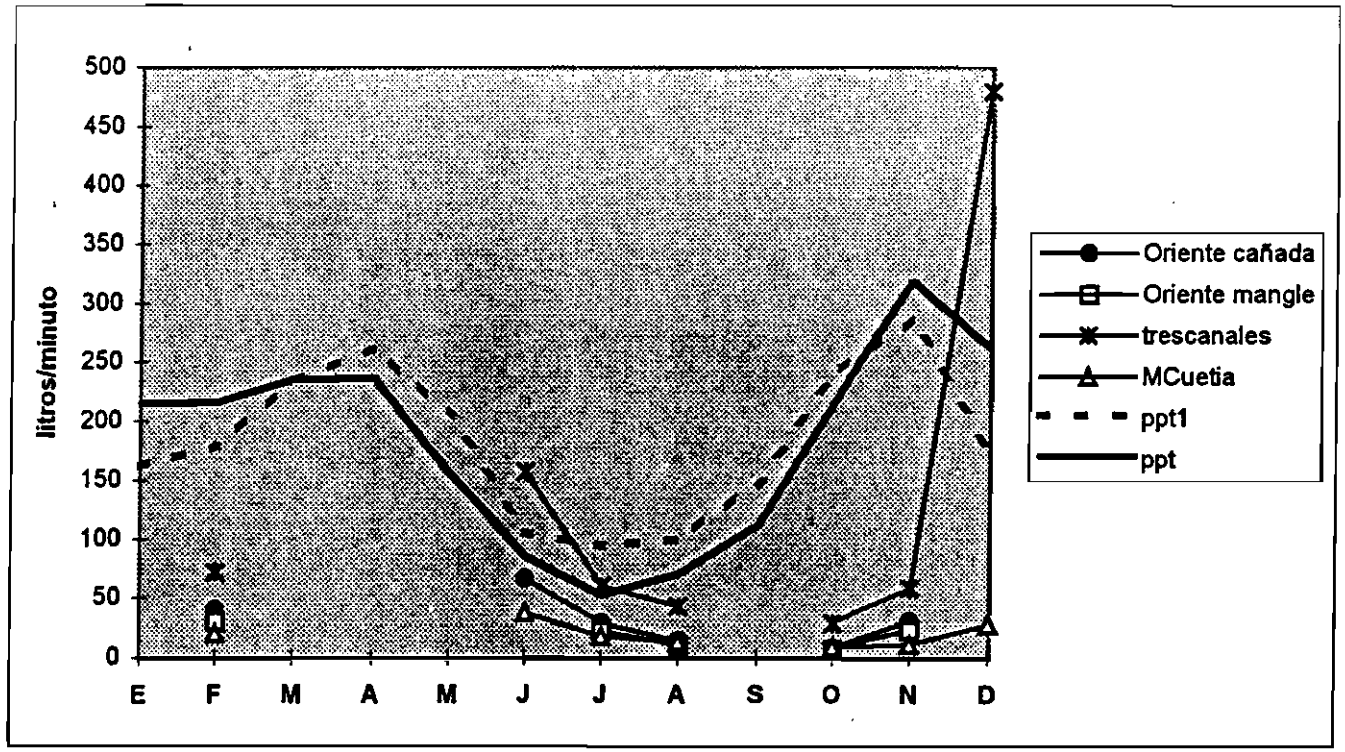
Fuentes para el suministro del agua según nivel de bienestar. Porcentaje de 724 agricultores. (Fuente: Encuesta CIPASLA 1993)

FUENTE	2	3
ACUEDUCTO Y OTRAS FUENTES ARTIFICIALES	44.6	31.4
NACIMIENTOS, LLUVIA, ALJIBES O RIO	12.9	10.2

Disponibilidad de nacimientos de agua en las fincas según nivel de Bienestar. Porcentaje de 721 agricultores (Fuente: Encuesta CIPASLA 1993)

	2	3
TIENE	10.4	10.2
NO TIENE	8.7	4.7
NO INFORMA	38.9	26.9

Caudales de 4 nacimientos de agua al interior de la subcuenca del rio Cabuyal



ppt1 = Estación de Mondomo
ppt = Estación de Piendamó
mm/mensual promedio de 15 años

LOCALIZACION DE LOS NACIMIENTOS DE AGUA AFORADOS

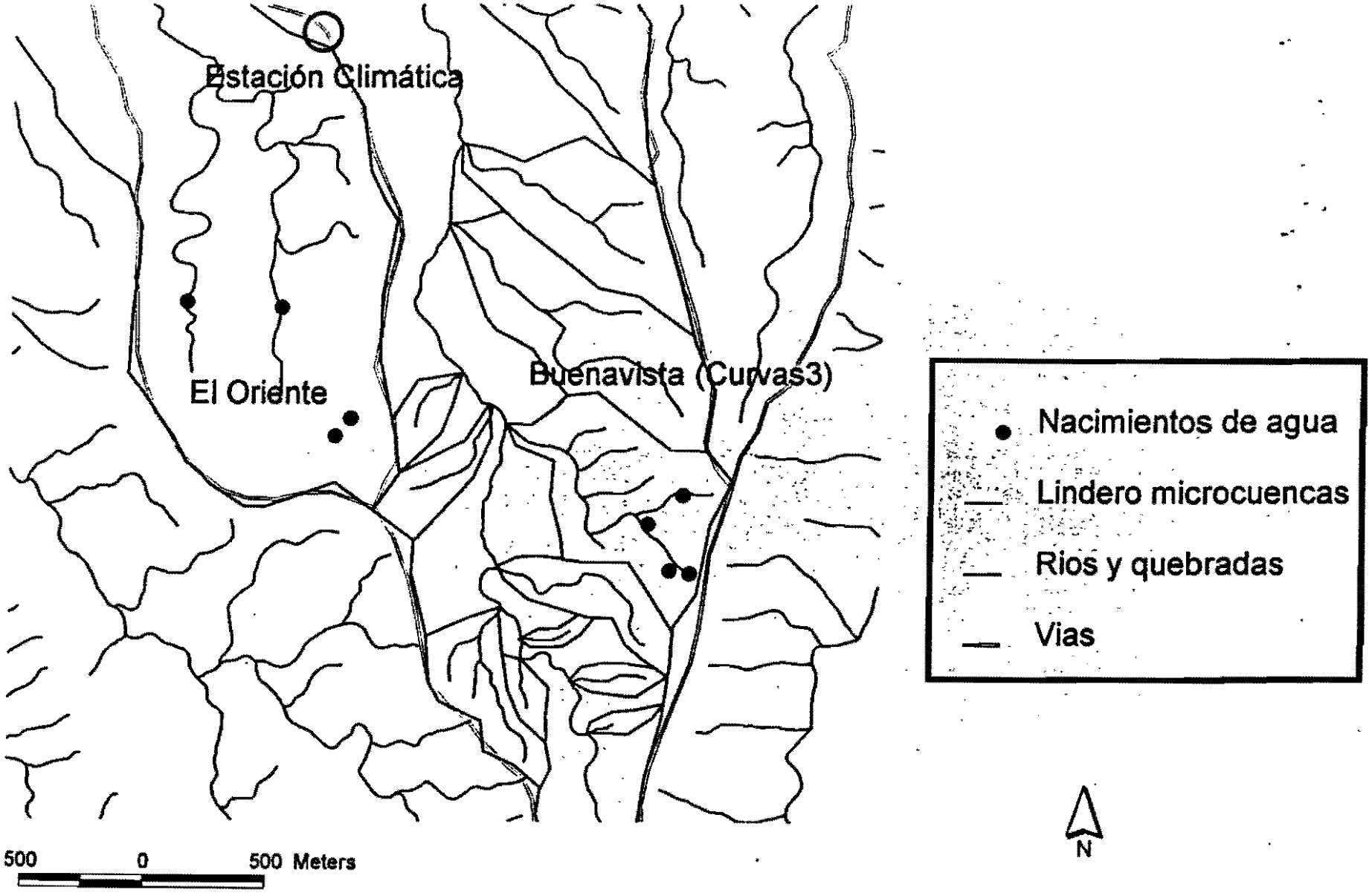
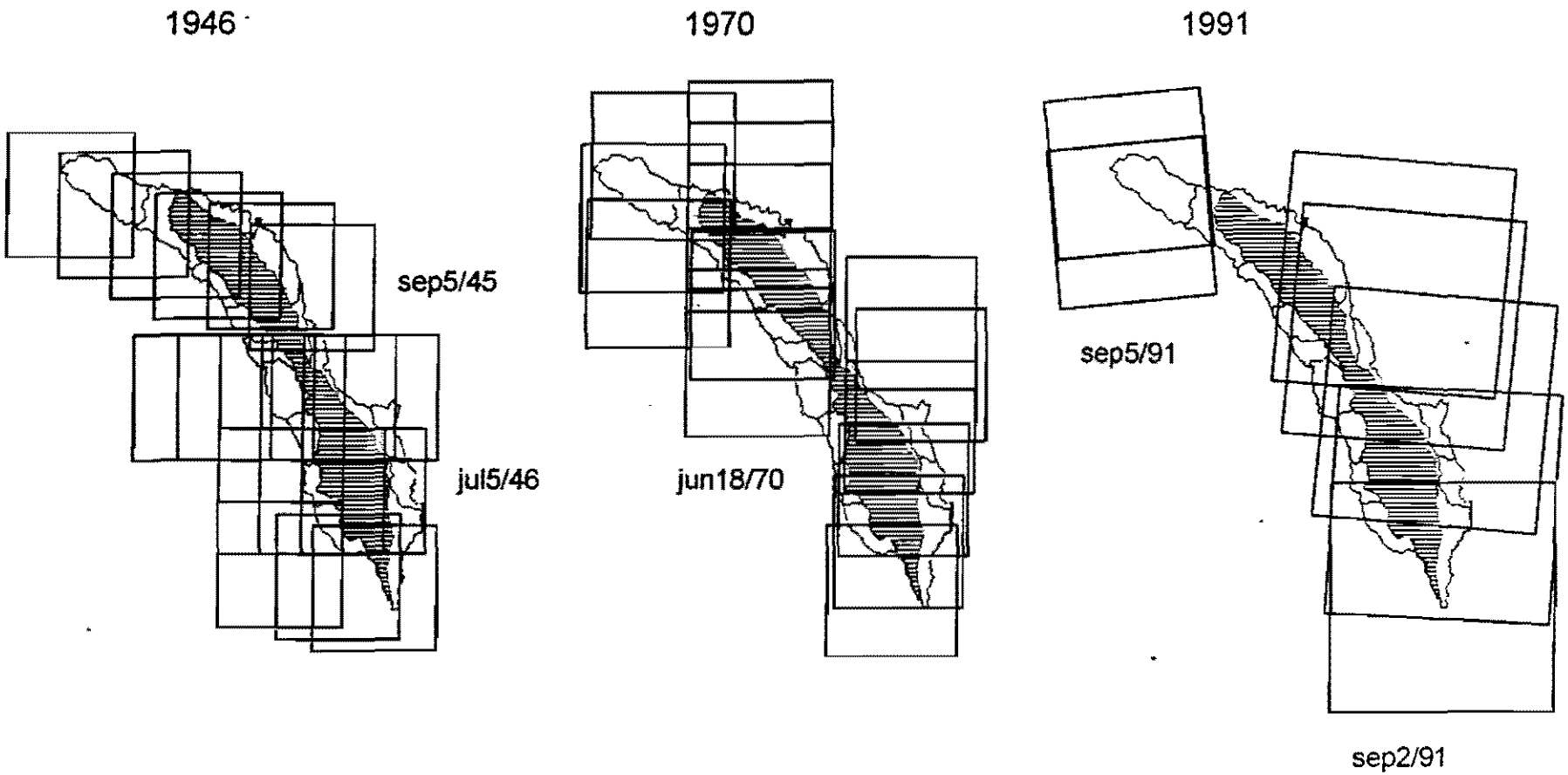
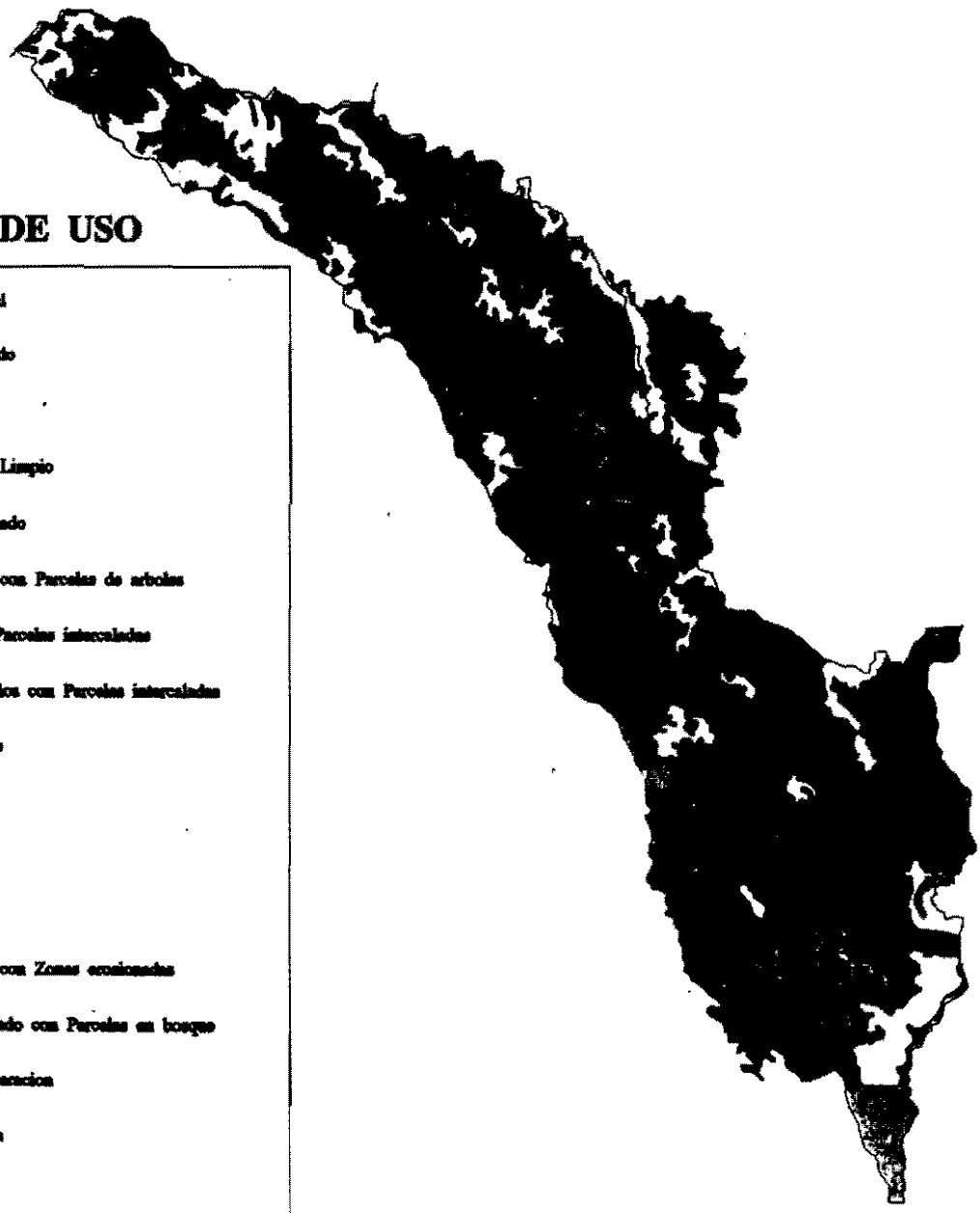


FIG. 1 COBERTURA DE LAS FOTOGRAFIAS AEREAS DE DIFERENTES SERIES
EN LA SUBCUENCA DEL RIO CABUYAL CALDONO - CAUCA



USO DE LA TIERRA 1994
SUBCUENCA DEL RIO CABUYAL

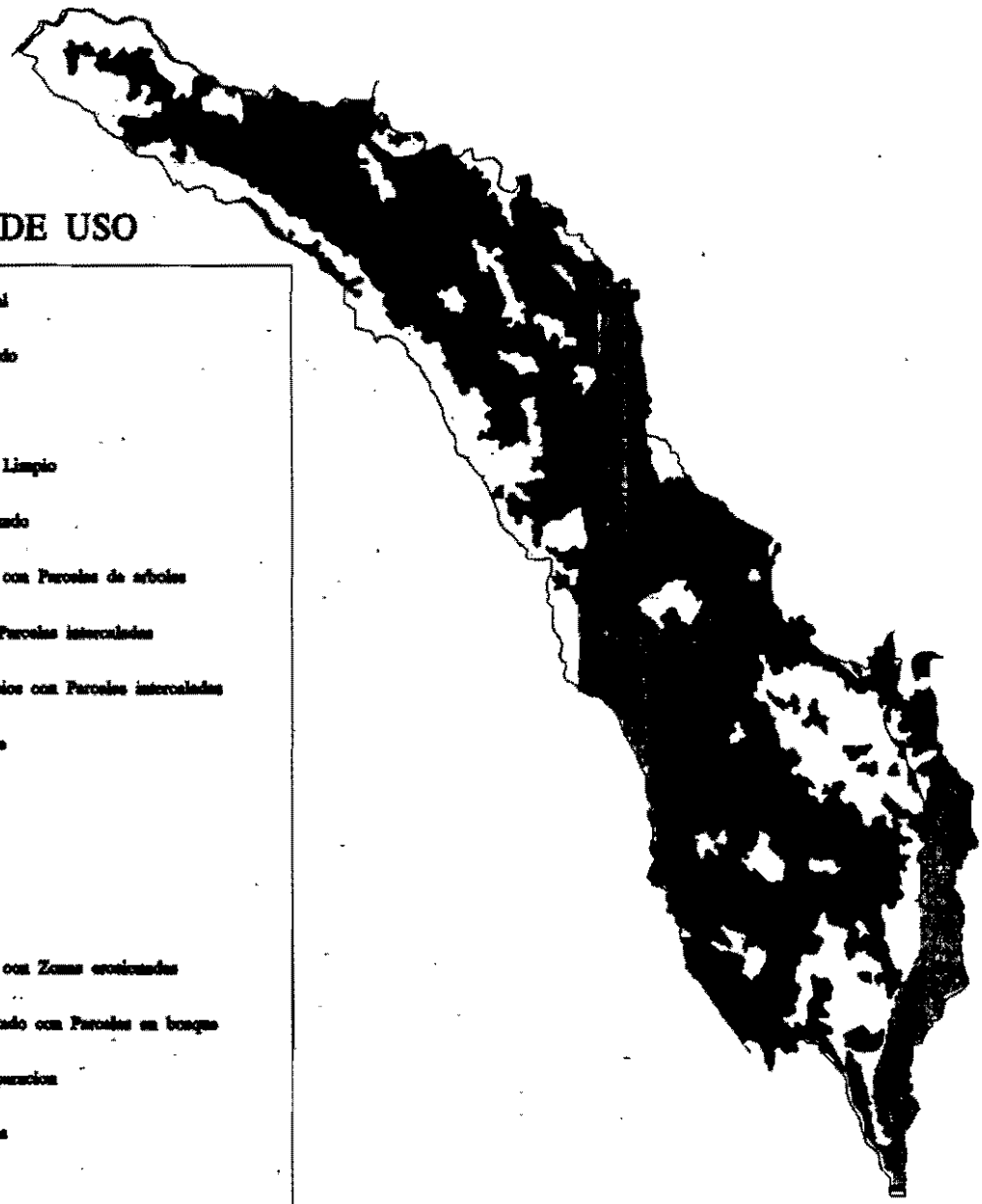


TIPO DE USO

- Bosque Natural
- Bosque Plantado
- Rastrojo
- Pasto Natural Limpio
- Pasto Enmalezado
- Pasto Natural con Parcelas de arboles
- Cultivos con Parcelas intercaladas
- Cultivos Limpios con Parcelas intercaladas
- Pasto de Corte
- Cafe
- Citricos
- Yuca
- Pasto Natural con Zonas enmalezadas
- Pasto enmalezado con Parcelas en bosque
- Tierra en preparacion
- Zona Quemada
- Piqua
- No existe informacion

ESCALA 1:125000

USO DE LA TIERRA 1970
SUBCUENCA DEL RIO CABUYAL

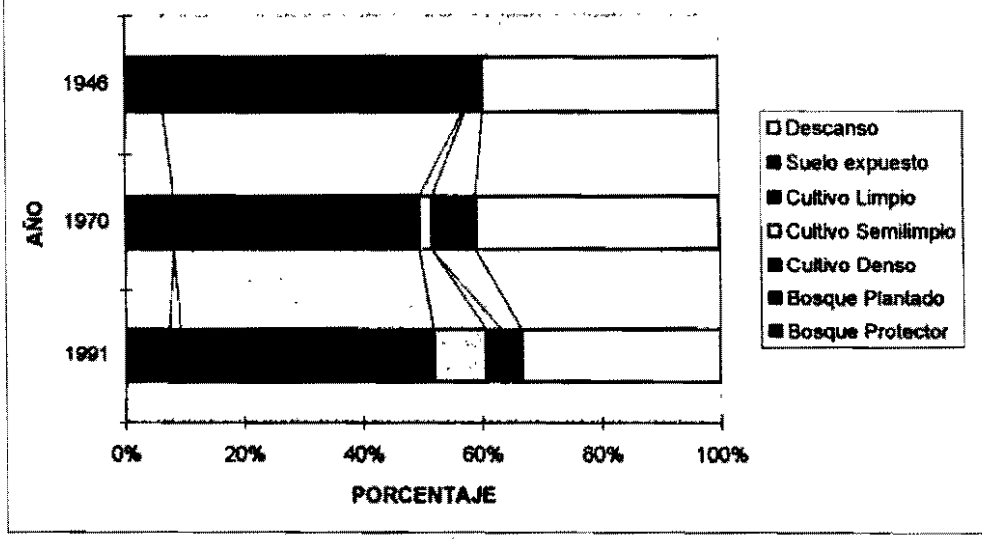


TIPO DE USO

- Bosque Natural
- Bosque Plantado
- Rastrojo
- Pasto Natural Limpio
- Pasto Enmalezado
- Pasto Natural con Parcelas de arboles
- Cultivos con Parcelas intercaladas
- Cultivos Limpios con Parcelas intercaladas
- Pasto de Corte
- Cafe
- Citricos
- Yuca
- Pasto Natural con Zonas erosionadas
- Pasto enmalezado con Parcelas en bosque
- Tierra en preparacion
- Zona Quemada
- Piqua
- No existe informacion

ESCALA 1:125000

FIG. 2 CAMBIO EN EL USO DEL SUELO - SUBCUENCA DE CABUYAL CAUCA - COLOMBIA



USO DEL SUELO	1991	1970	1946
		%	
Bosque Protector	7.36	8.19	6.43
Bosque Plantado	1.91	0.00	0.00
Cultivo Denso	42.56	41.34	50.34
Cultivo Semilimpio	8.84	2.14	0.46
Cultivo Limpio	2.59	0.00	0.00
Suelo expuesto	3.39	7.33	2.95
Descanso	33.34	40.99	39.83
TOTAL(has)	7063.425	6505.762	13431.44

- FIG. 3 CAMBIOS DE USO DE LA TIERRA ENTRE 1946 Y 1970
SUBCUENCA DEL RIO CABUYAL - CAUCA - COLOMBIA

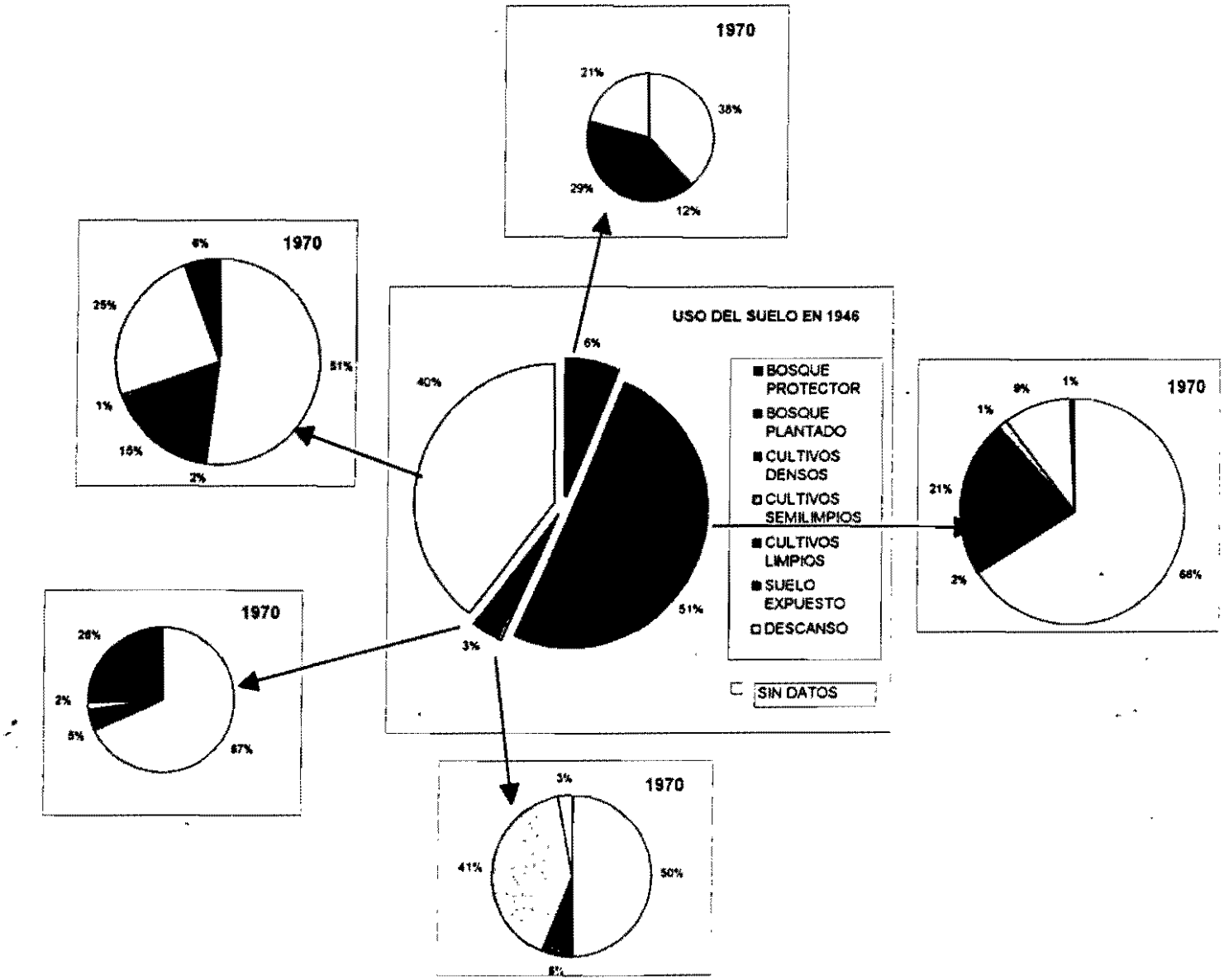


FIG. 4 CAMBIOS DE USO DE LA TIERRA ENTRE 1970 Y 1991
SUBCUENCA DEL RIO CABUYAL - CAUCA - COLOMBIA

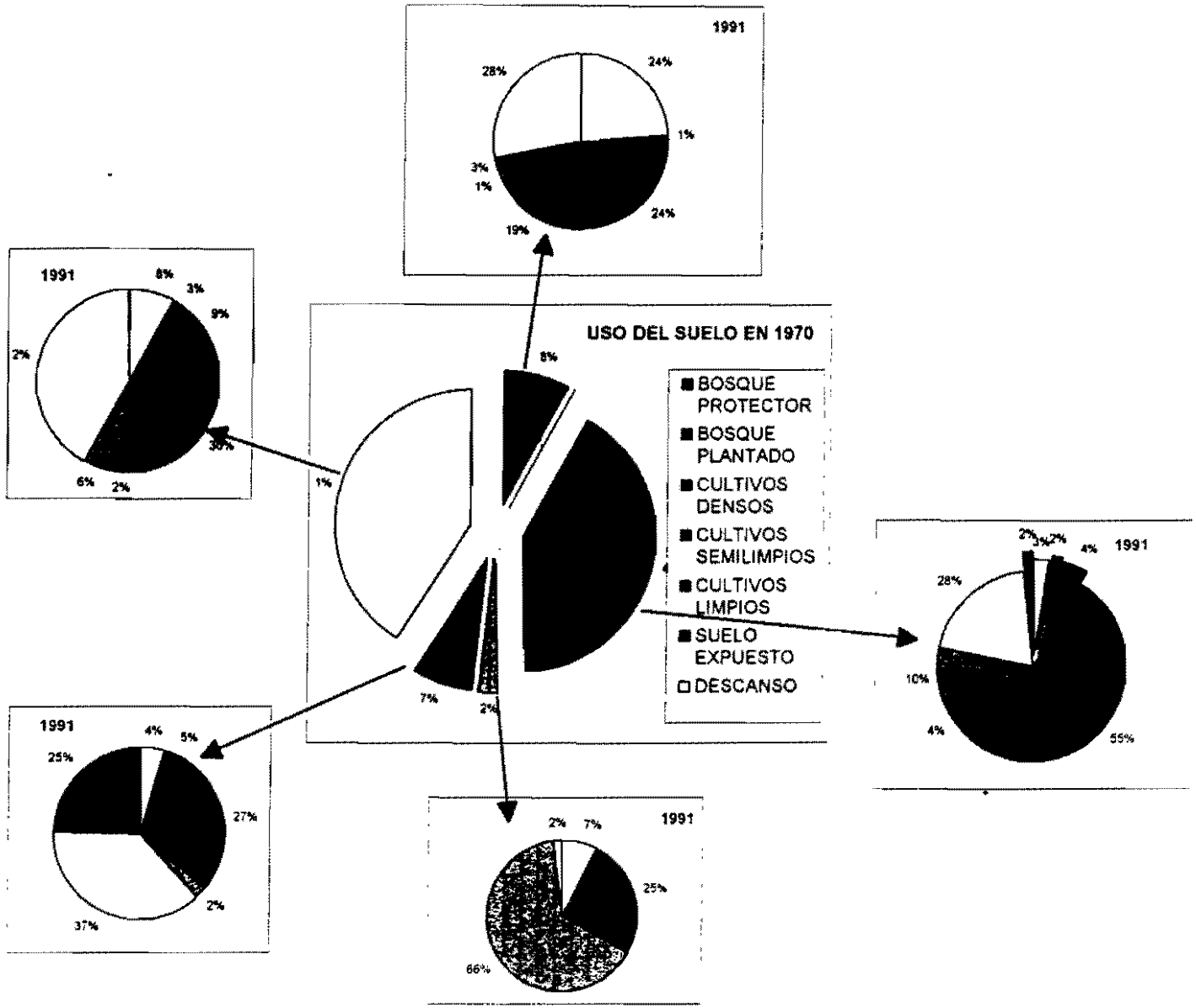
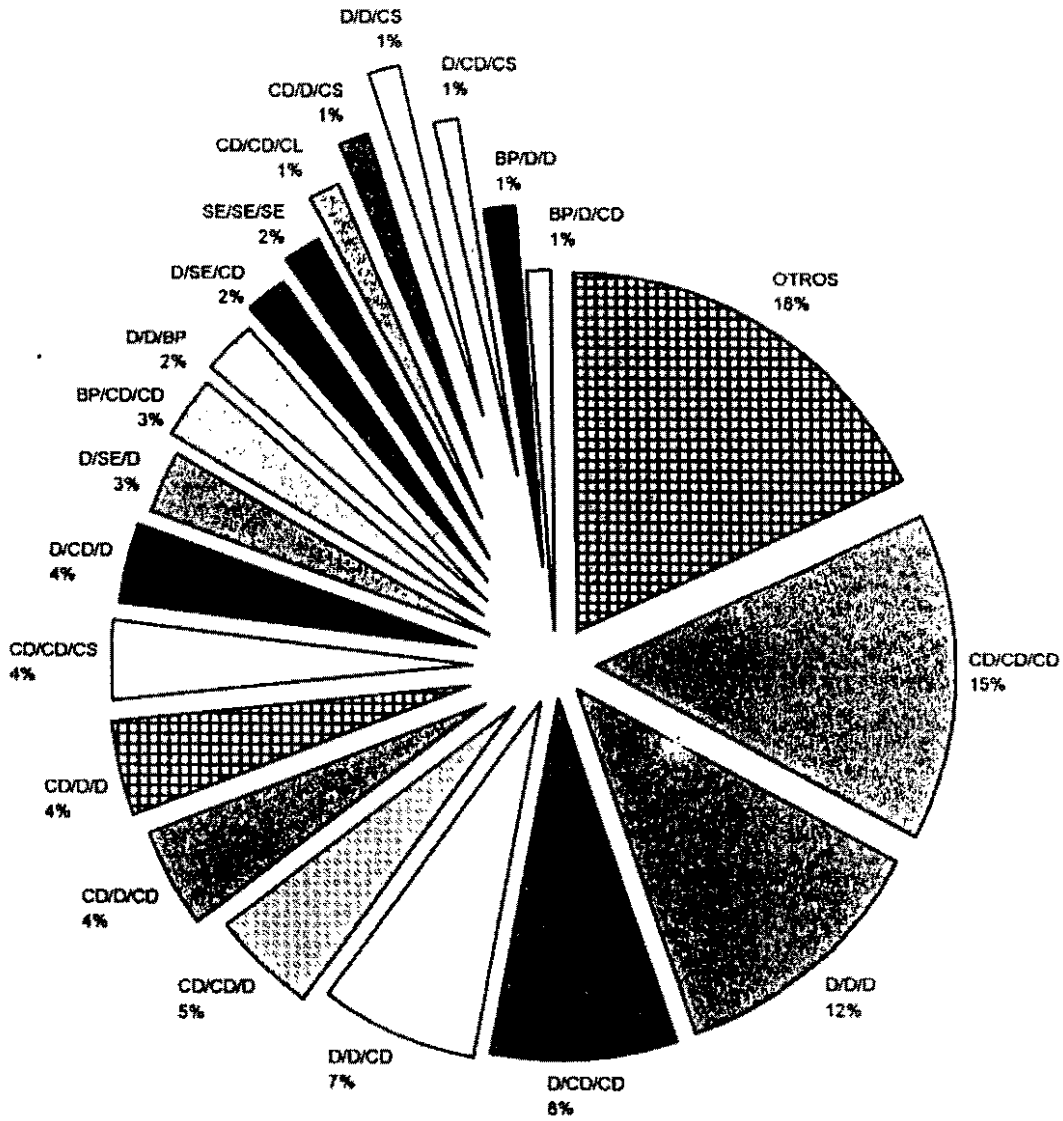
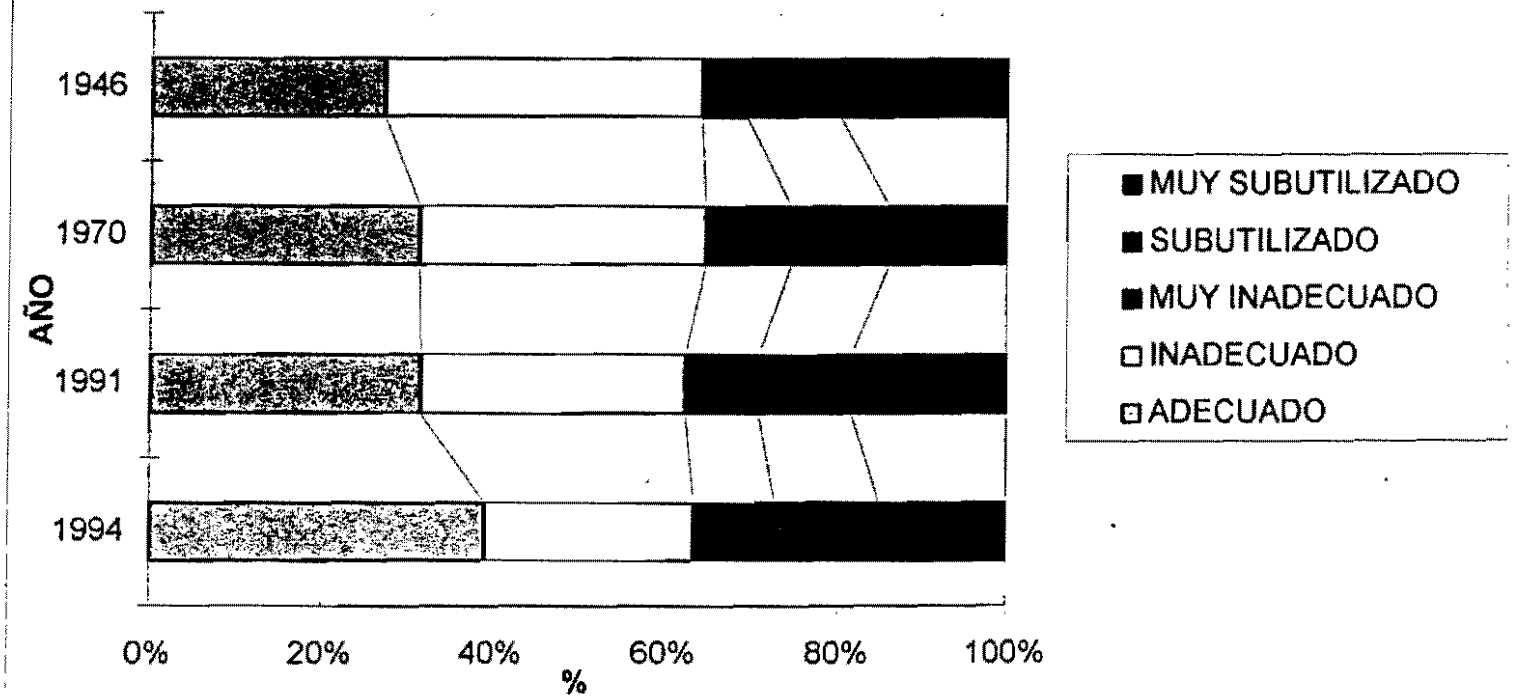


Figura 5. Ciclos de usos agregados de la tierra y su porcentaje según las series de 1946/1970 y 1991 en la subcuenca del rio cabuyal - Cauca - Colombia



BP = Bosque protector Natural
CD = Cultivos Densos
D = Descanso
CS = Cultivo Semilimpio
SE = Areas con suelo expuesto
CL = Cultivo Limpio

FIG. 6 CAMBIOS DE USOS EN CONFLICTO SUBCUENCA RIO CABUYAL CAUCA - COLOMBIA



1946

1970

1991

1 0 1 2 Kilometers

Usos

- Bosque Plantado
- Bosque Protector
- Cultivos Densos
- Cultivos Limpios
- Cultivos Semilimpios
- Descanso
- Suelo Expuesto

(1) NOMBRE:_____ (2) CODIGO:_____ (3) NRO. LOTES EN CULTIVO :_____ (4) NRO. LOTES EN BOSQUE :_____ (5) NRO. LOTES EN PASTO :_____ (6) NRO. LOTES EN DESCANSO :_____

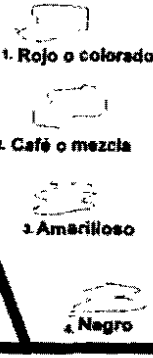
(7) NRO. TOTAL DE LOTES:_____ (8) LOTE:_____ (9) CICLO:_____ (10) AREA:_____ (11) TENENCIA: Propio:___ Arrendado:___ En compañía:___ (12) FECHA:_____

PENDIENTE DEL SUELO

Salió a jornalear?

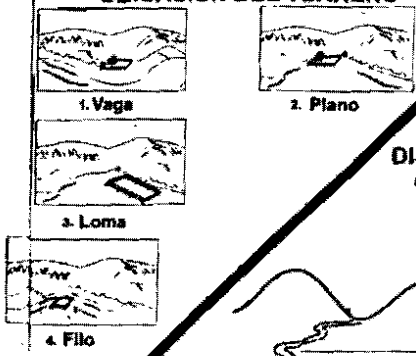
Si___No___

COLOR DEL SUELO

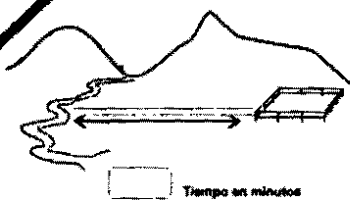


TEXTURA DEL SUELO

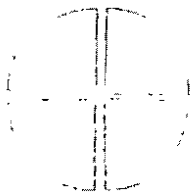
UBICACION DEL TERRENO



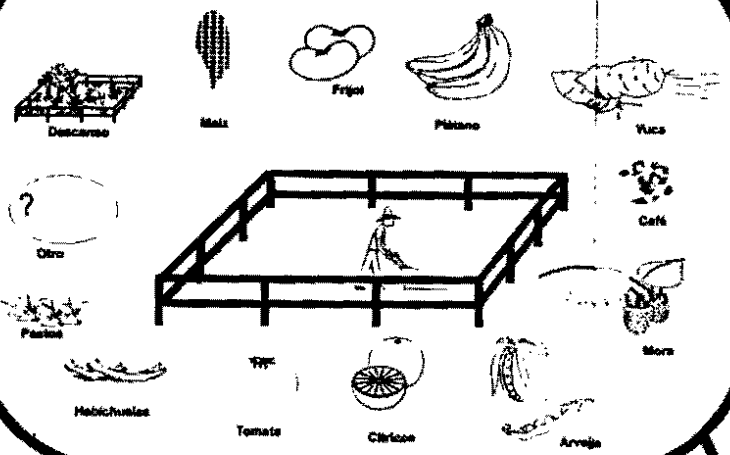
DISTANCIA A LA CARRETERA



PROPORCION DEL TIEMPO DEDICADO A LOS LOTES PROPIOS EN RELACION CON LOTES AJENOS



CULTIVO SEMBRADO.



DESCANSO DEL TERRENO

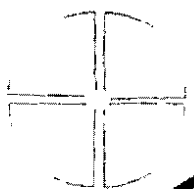
Tiempo desde cuando dejo de descansar:

Años:_____Meses:_____ Nunca:___

Tiempo que duró descansando:

Años:_____Meses:_____

PROPORCION DE JORNALES CONTRATADOS EN COMPARACION CON LOS PROPIOS



CUANTOS JORNALES CONTRATO PARA:

___Preparación y Siembra

___Desyerbas

___Cosecha

PREPARACION DEL LOTE

___Quemó

___Preparó manualmente

___Aró con bueyes

___Aró con tractor

Gallinaza

Si___No___

Cuántos bultos?___

Veneno

Si___No___

Número de fumigaciones?___

Abonos quimicos

Si___No___

Cuántos bultos?___

INSUMOS UTILIZADOS

ANTERIOR CULTIVO EN EL LOTE

PORQUE SELECCIONO ESTE CULTIVO?_____

_____

_____

GRUPOS DE TARJETAS

Importantes

No tan Importantes

No importantes

Destino de los principales productos cultivados en la subcuenca del rio Cabuyal según los niveles de bienestar 2 y 3. Porcentaje de 720 agricultores.
(Fuente: Encuesta CIPASLA 1993)

	Venta directa o con intermediario		Sólo o la mayoría para el consumo		No cultiva	
W B	2	3	2	3	2	3
YUCA	30.9	16.9	5.9	4.9	21.8	19.8
FRIJOL	13.8	6.5	7.6	3.2	36.5	32.1
MAIZ	2.7	0.6	21.4	12.3	33.7	28.7
CAFE	49.8	33.3	3.1	3.0	5.1	5.4
PLATANO	4.7	2.9	46.38	31.9	7.0	6.9
HORTALIZA	1.2	0	4.7	1.9	52.1	39.2

Fuentes de leña según nivel de bienestar. Porcentaje de 703 agricultores.
(Fuente: Encuesta CIPASLA 1993)

FUENTE	2	3
COMPRA LEÑA	4.8	3.9
LA RECOGE CERCA	32.5	21.3
LA RECOGE LEJOS	20	17.2

Fuente de combustible para la cocción de alimentos (primera opción) según nivel de bienestar. Porcentaje de 721 agricultores. (Fuente: Encuesta CIPASLA 1993)

FUENTE	2	3
LEÑA	56	41.3
ELECTRICIDAD	1.9	0

CLASIFICACION DE LOS SISTEMAS DE LOTES REPORTADOS EN EL CENSO DE LA SUBCUENCA DEL RIO CABUYAL

TIPO DE SISTEMA	No LOTES	%	AREA (Plazas)	%
CON CAFE				
CAFE X P/TES	977	37.00	1281.56	42.00
CAFE X P/TES Y TEMP.	274	10.43	408.1	13.21
TEMP. X CAFE	88	3.35	104.28	3.38
	1339	**50.95**	**1793.94**	**58.08**
SIN CAFE				
P/TES MONOCULTIVO	294	11.19	316.34	10.24
P/TES ASOCIADOS	35	1.33	36	1.17
TEMP. MONOCULTIVOS	496	18.87	426.2	13.80
TEMP. ASOCIADOS	390	15.00	470.93	15.00
OTRAS ASOCIACIONES	74	2.82	49.4	1.60
	1289	**49.05**	**1294.87**	**41.92**
TOTAL LOTES	**2628**	**100.00**	**3088.81**	**100.00**

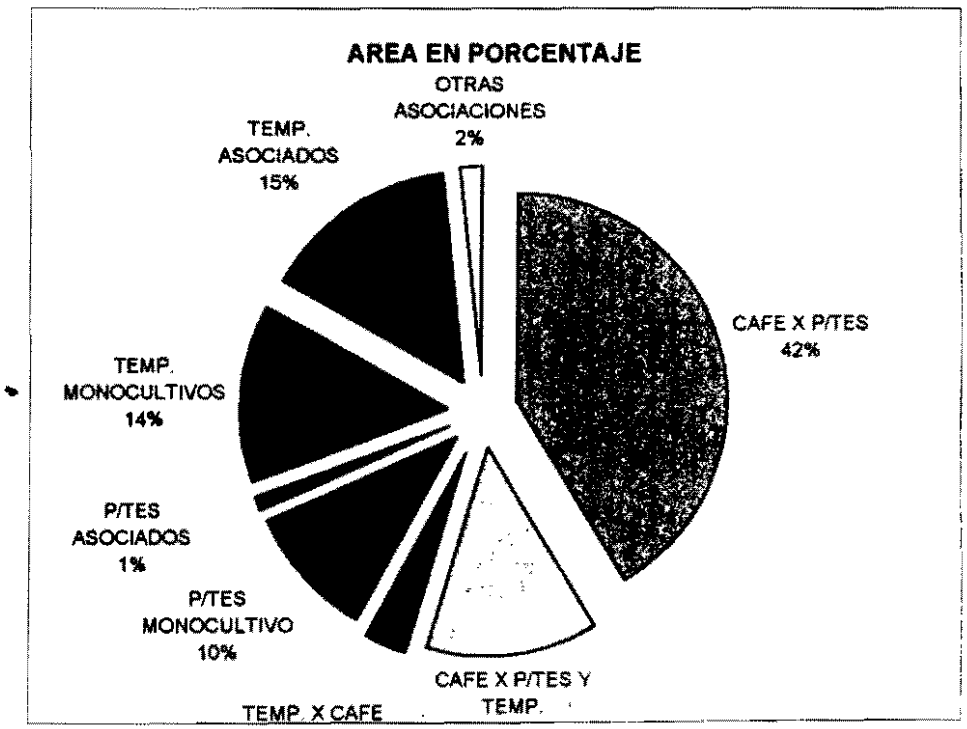
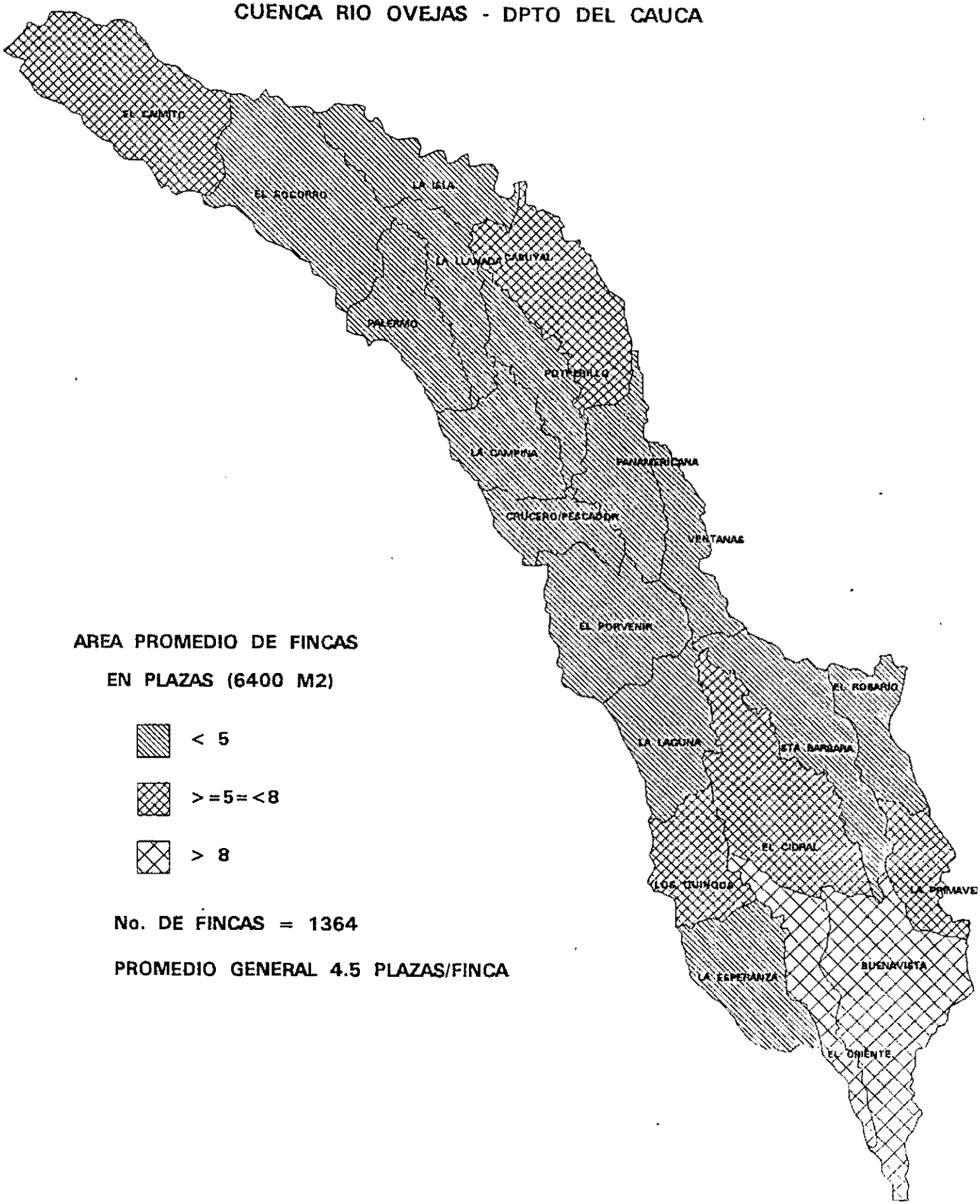


Tabla 2. Clasificación de los sistemas de lotes reportados en el censo de CIPASLA.

TIPO DE SISTEMA	COMPONENTES DEL SISTEMA	No LOTES	%	AREA (Plazas)	%
CON CAFE					
CAFE X P/TES	CAFE	148		183.26	
	CAFE X PLATANO	332		439.72	
	CAFE X FRUTAS	38		34.23	
	CAFE X P/TE (-PLAT O FRUTA)	18		20.09	
	Subtotal	536	20	677.3	22
	CAFE X PLATANO X PASTO	71		89.78	
	CAFE X PLATANO X FRUTA	156		211.84	
	CAFE X FRUTAS X PASTO	25		32.16	
	CAFE X PLATANO X P/TE(-FRUTA O PLAT.)	69		88.98	
	CAFE X PLATANO X FRUTA X PASTO	120		181.5	
	Subtotal	441	17	604.26	20
CAFE X P/TES Y TEMP.	CAFE X PLATANO X YUCA X 1(TEMP/PTES)	34		71.08	
	CAFE X 2 O 3 (PTES/TEMP)	15		21	
	CAFE X PLATANO X 2 (PTES/TEMP)	54		66.28	
	CAFE X 4 O 5 (TEMP/PTES)	68		102.14	
	CAFE X PLAT. X PASTO X FRUT X 1 O 2(PTES/TEMP)	87		132.91	
	CAFE X 1 O 2 TEMP.	16		14.69	
	Subtotal	274	10	408.1	13
TEMP. X CAFE	YUCA O FRIJOL O MAIZ X CAFE	10		12	
	(-CAFE)X 4 O 5 (PTES/TEMP)	70		88.7	
	1 O 2 X CAFE	8		3.58	
	Subtotal	88	3	104.28	3
	TOTAL	1339	51	1793.94	58
SIN CAFE					
P/TES MONOCULTIVO	PASTO	124		181.3	
	CAÑA	97		74	
	PLATANO O FRUTAS	53		38.54	
	CABUYA	20		22.5	
	Subtotal	294	11	316.34	10
P/TES ASOCIADOS	2 O 3 PTES SIN CAFE	35		36	
	Subtotal	35	1	36	1
TEMP. MONOCULTIVOS	YUCA	306		302.58	
	TOMATE	60		27.75	
	MAIZ	54		35	
	FRIJOL	41		44.16	
	OTRO	35		16.71	
	Subtotal	496	19	426.2	14
TEMP. ASOCIADOS	YUCA X FRIJOL	111		158.52	
	YUCA X MAIZ	54		73.2	
	YUCA X FRIJOL X MAIZ	52		64.31	
	YUCA X 1 O 2 (PTES/TEMP)	55		57.67	
	Subtotal	272	10	353.7	11
	FRIJOL X YUCA	11		18.45	
	FRIJOL X MAIZ	44		42.7	
	FRIJOL X MAIZ X YUCA	6		7	
	FRIJOL X 1 O 2 (PTES/TEMP)	11		12.8	
	Subtotal	72	3	80.95	3
	MAIZ X FRIJOL	21		11.4	
	MAIZ X 1 O 2 (PTES/TEMP)	25		20.88	
	Subtotal	46	2	32.28	1
OTRAS ASOCIACIONES	OTRO TEMP X 1 (PTE/TEMP)	30		10.44	
	OTRAS	44		38.96	
	Subtotal	74	3	49.4	2
	TOTAL	1289	49	1294.87	42
	TOTAL LOTES	2628	100	3088.81	100

SUBCUENCA DE CABUYAL

CUENCA RIO OVEJAS - DPTO DEL CAUCA



AREA PROMEDIO DE FINCAS

EN PLAZAS (6400 M2)

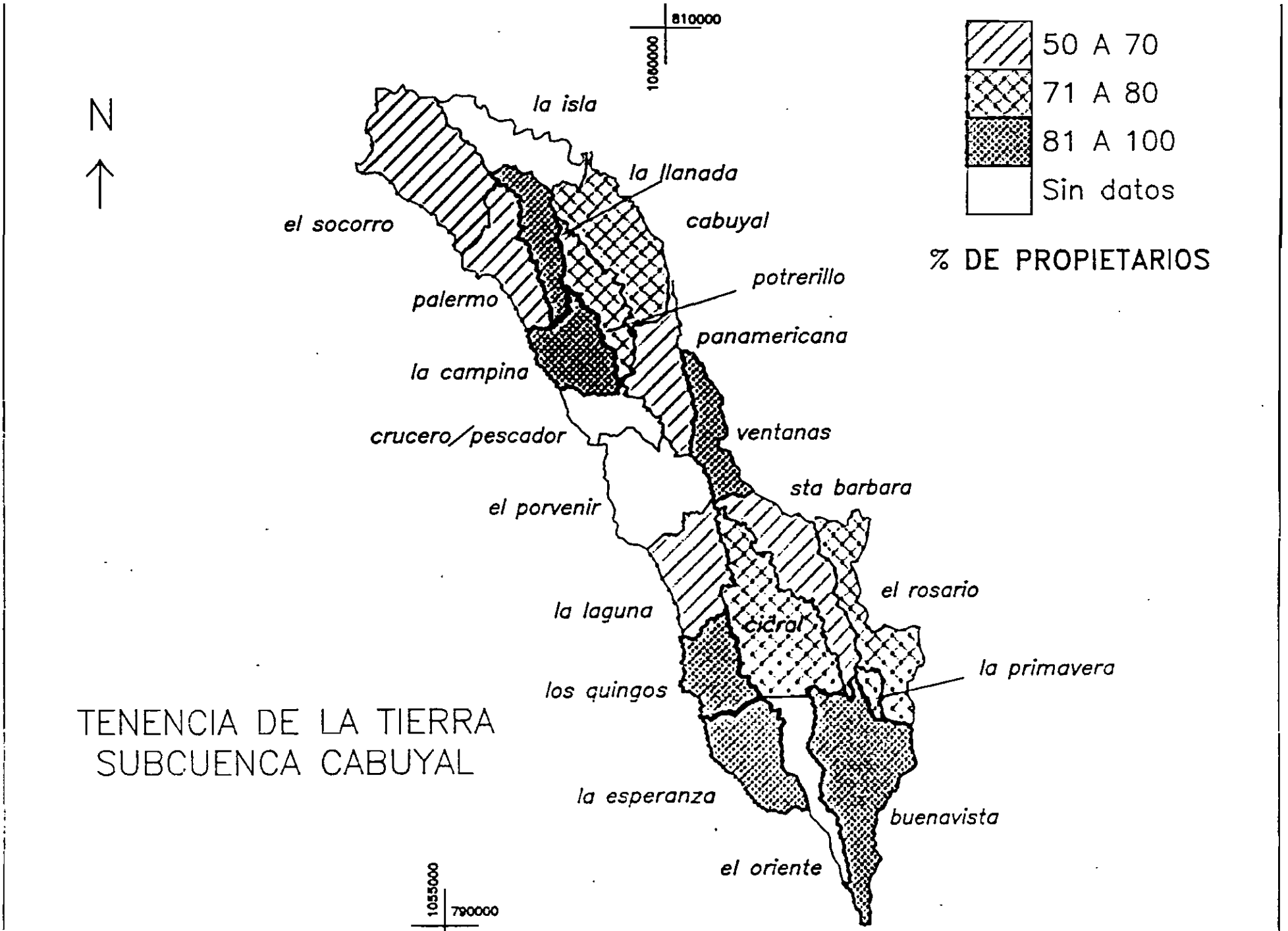
< 5

>=5=<8

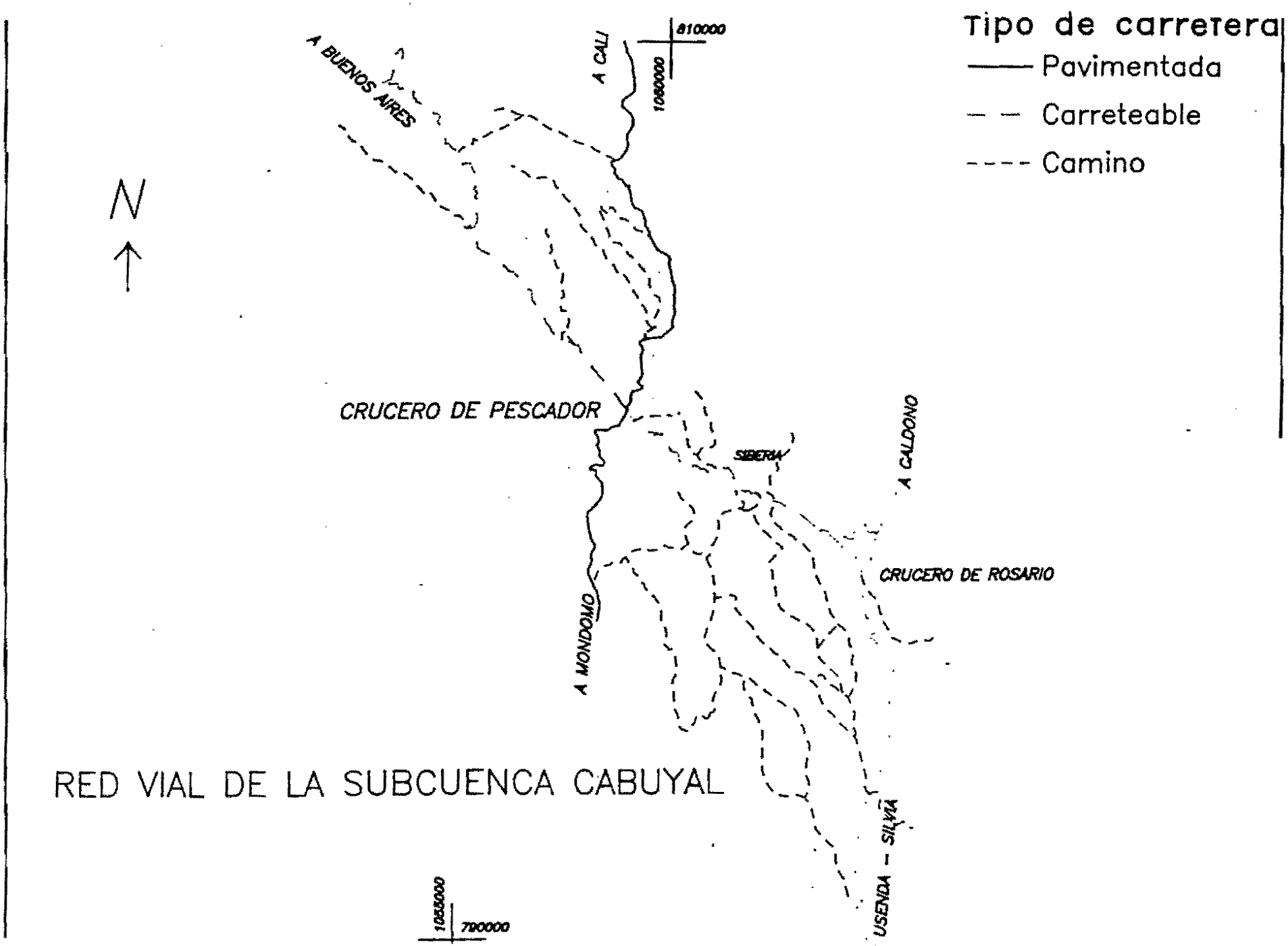
> 8

No. DE FINCAS = 1364

PROMEDIO GENERAL 4.5 PLAZAS/FINCA

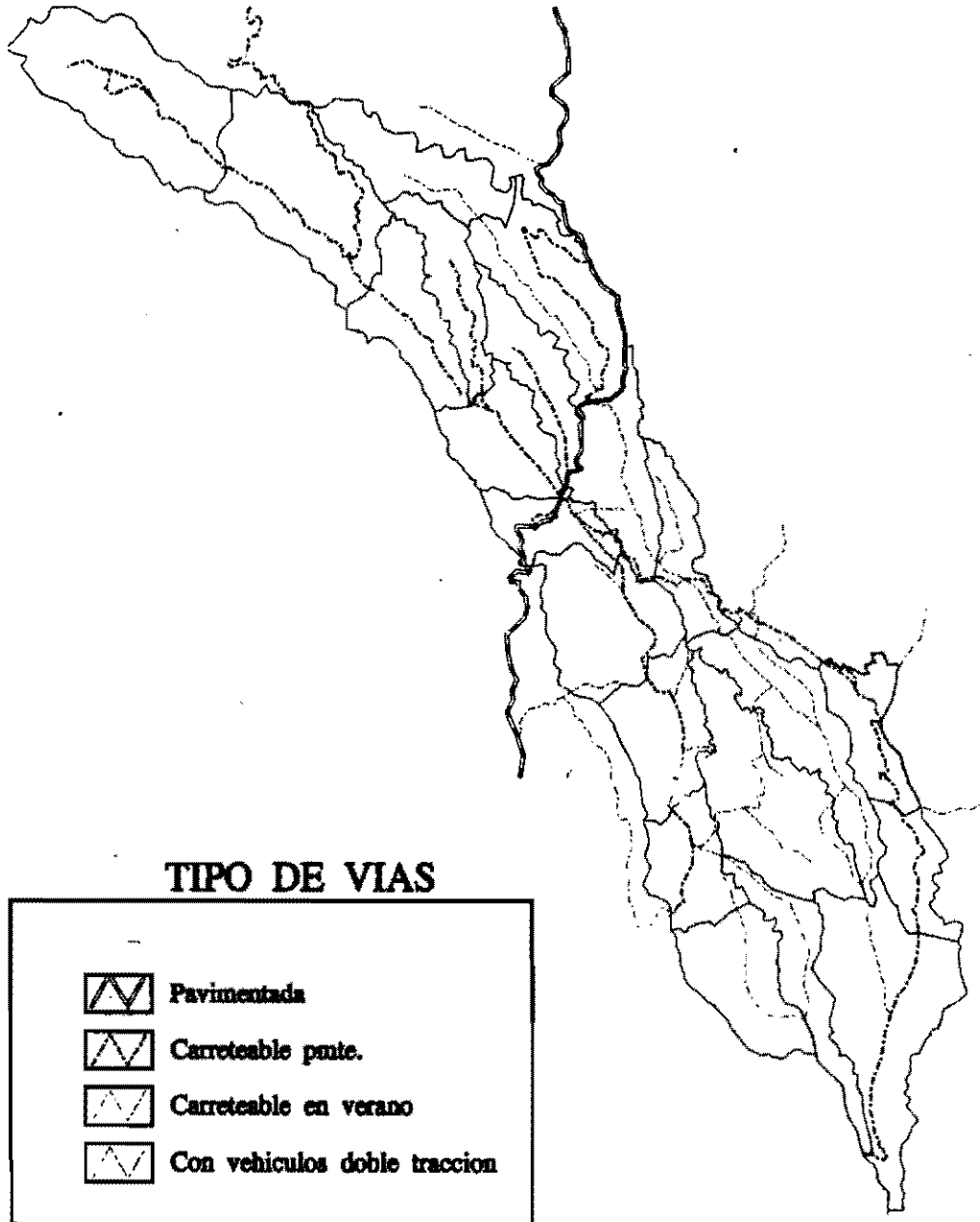


TENENCIA DE LA TIERRA
SUBCUENCA CABUYAL



RED VIAL DE LA SUBCUENCA CABUYAL

CARRETERAS Y CAMINOS RURALES
SUBCUENCA DEL RIO CABUYAL



TIPO DE VIAS

- Pavimentada
- Carreteable pmte.
- Carreteable en verano
- Con vehiculos doble traccion

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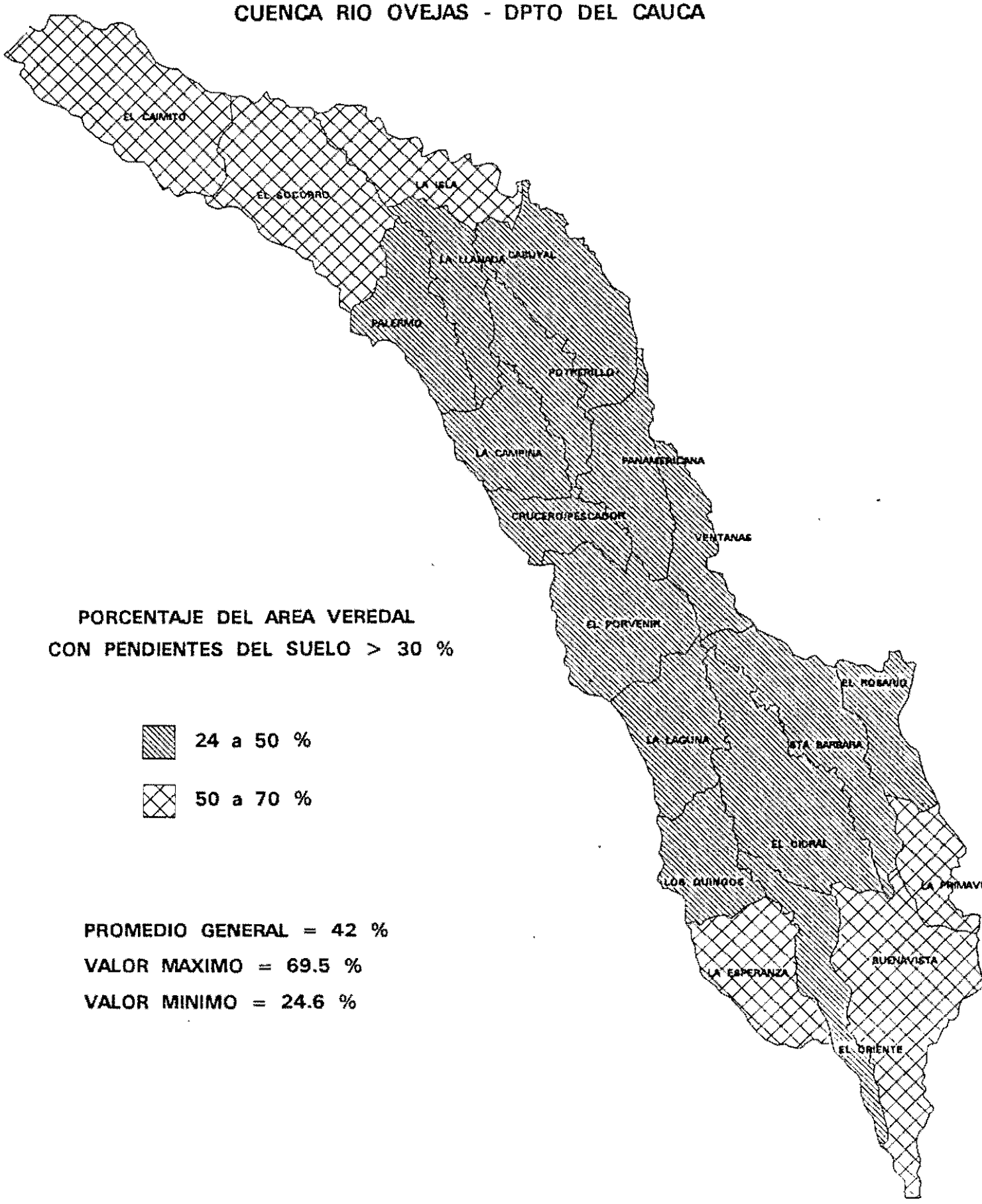
SUBCUENCA DE CABUYAL

CUENCA RIO OVEJAS - DPTO DEL CAUCA



PORCENTAJE DEL AREA VEREDAL
CON PENDIENTES DEL SUELO > 30 %

24 a 50 %

50 a 70 %

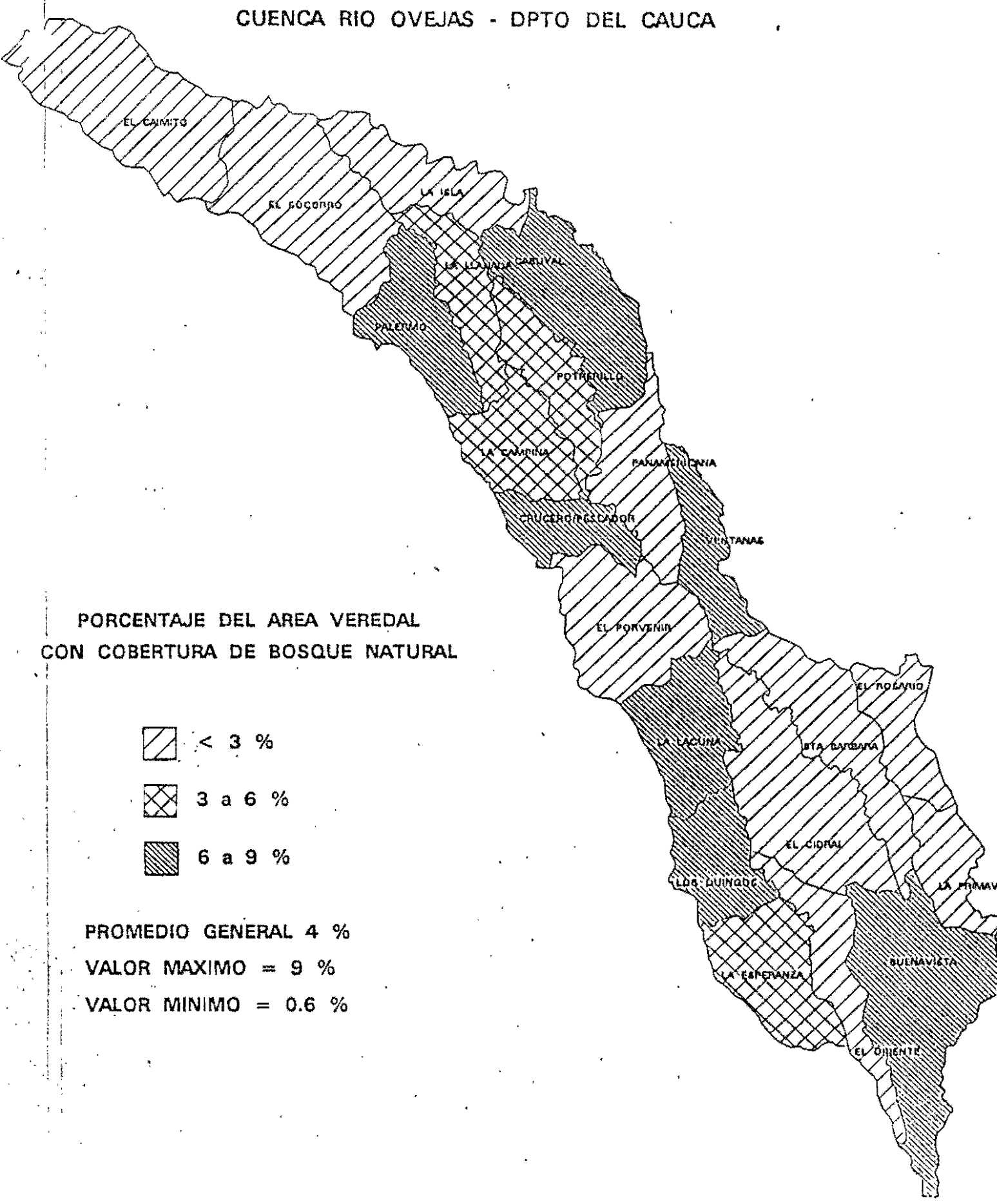
PROMEDIO GENERAL = 42 %

VALOR MAXIMO = 69.5 %

VALOR MINIMO = 24.6 %

SUBCUENCA DE CABUYAL

CUENCA RIO OVEJAS - DPTO DEL CAUCA



PORCENTAJE DEL AREA VEREDAL
CON COBERTURA DE BOSQUE NATURAL

< 3 %

3 a 6 %

6 a 9 %

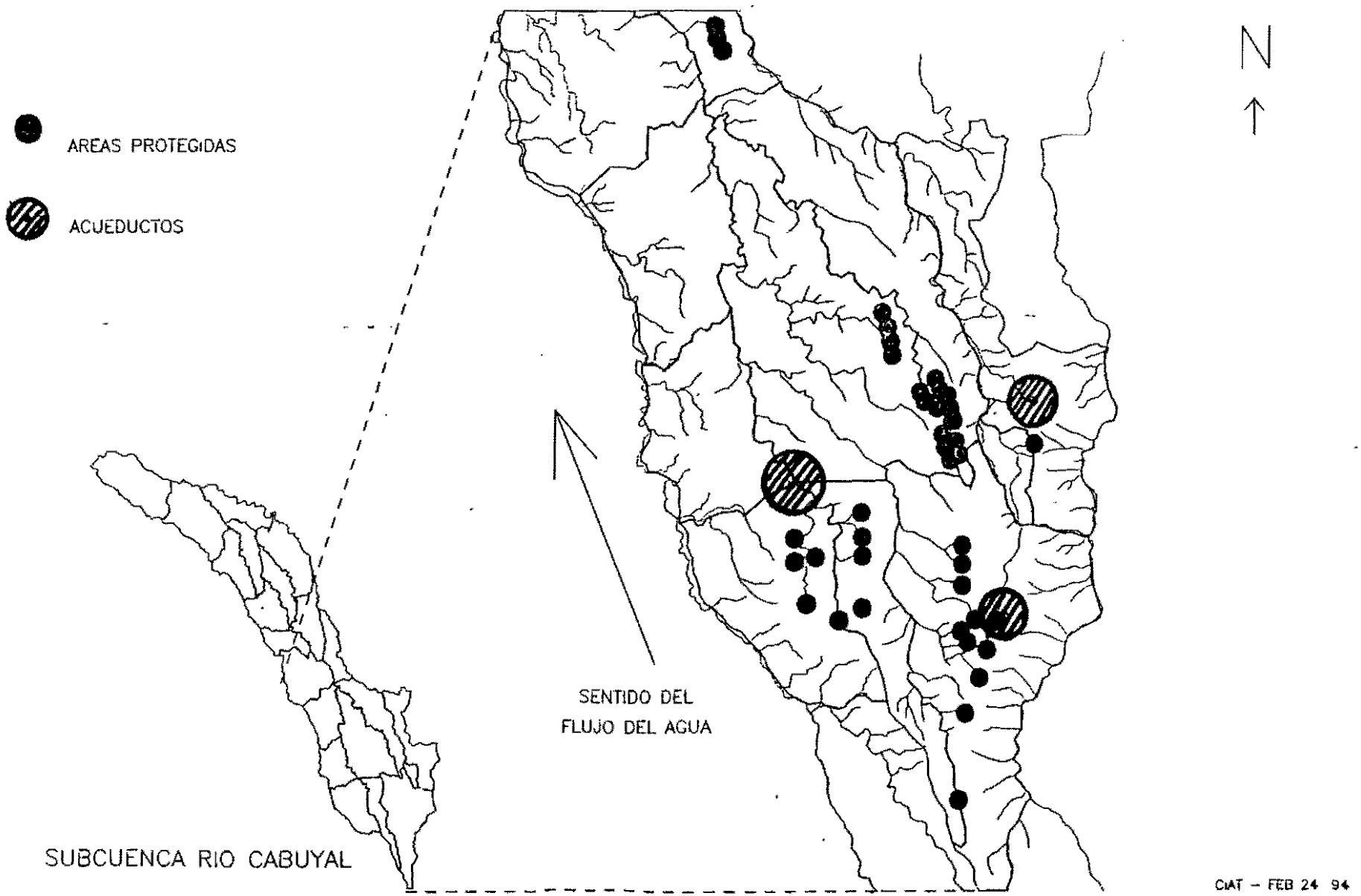
PROMEDIO GENERAL 4 %

VALOR MAXIMO = 9 %

VALOR MINIMO = 0.6 %

FUENTES DE AGUA PROTEGIDAS AL INTERIOR DE LA SUBCUENCA DEL RIO CABUYAL

(ZONA ALTA)



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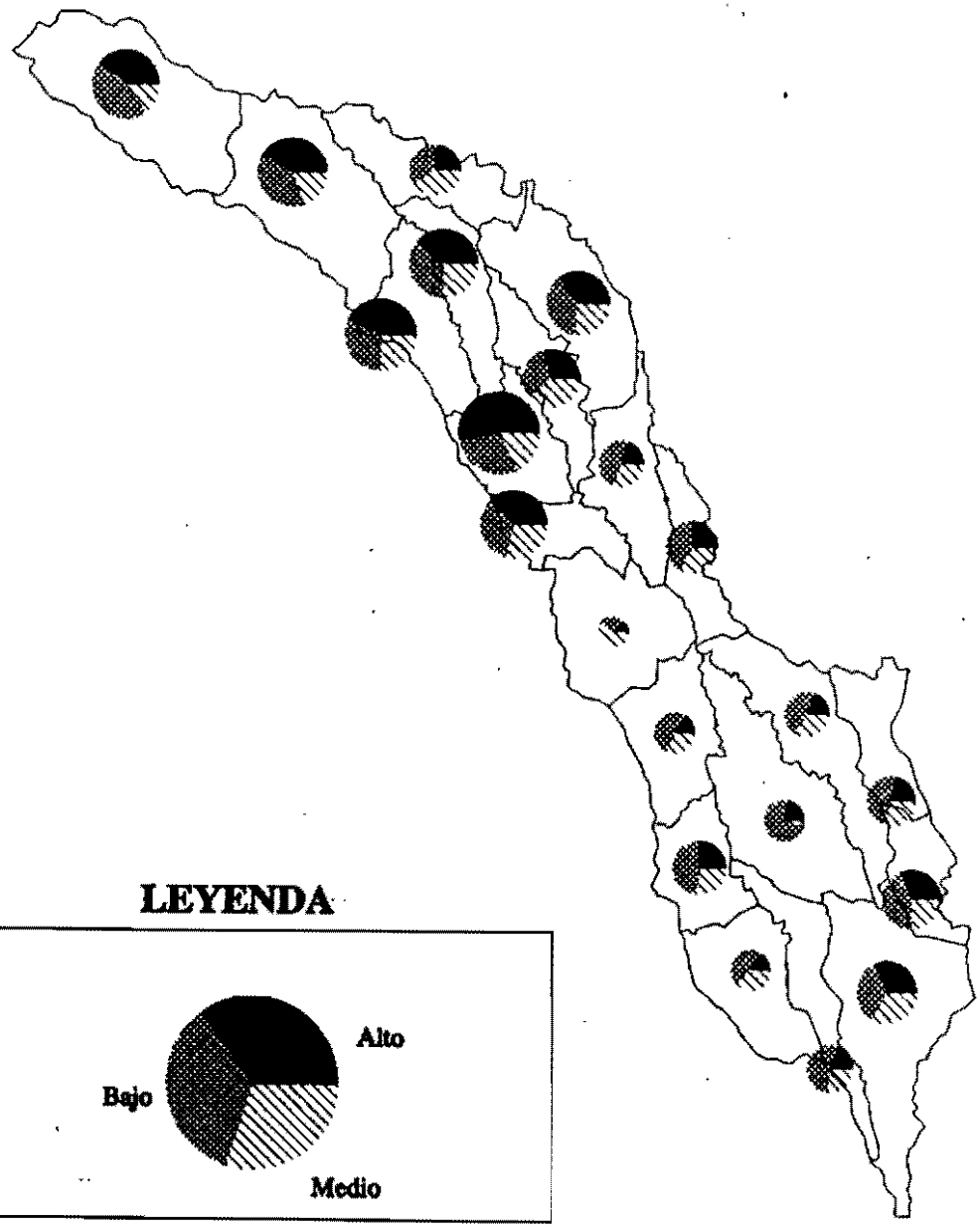
NIVELES DE BIENESTAR POR VEREDA
SUBCUENCA DEL RIO CABUYAL



LEYENDA

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Level of well-being in Rio Cabuyal
Percent households per well-being category by vereda

	Highest level of well-being[1]	Medium level of well-being	Lowest level of well-being[2]
El Socorro (n=71) *	31	38	31
La Isla (n=19) *	5	32	63
Panmamericana ** (n=43)	19	58	23
Porvenir (n=49)**	20	20	59
La Laguna (n=96)***	15	38	48
Ventanas (n=64)**	25	56	19
Santa Barbara *** (n=62)	23	44	34
Buena Vista (n=49)***	20	55	25
Crucero el Rosario (n=85) ***	25	44	32
El Oriente (n=11)***	0	36	64
La Llanada (n=52)*	21	33	46
TOTAL (N=601)	21	42	37

[1] According to the roughly 30 persons who have been undertaking well-being rankings, a high level of well-being is associated with having good houses with all the facilities, being free from the need to work as day labourers for other farmers, having income sources other than farming, being able to employ people and give loans and parties to neighbours.

[2] A low level of well-being is associated with having day labouring for other farmers as the major income source, having to buy food every day with the money earned during the day (as opposed to being able to go to the market once a week), not getting enough to eat and/or having to ask for 'loans' from better-off farmers (to be repaid in labour) in order to buy food during the slack season, not having any land but perhaps renting in land, having many small children and not being able to educate them and having houses with carton roofs.

Note * lower
** Mid
*** Highest

Table 1. Access to natural resources by well-being category

	Highest level of well-being (n=258)	Middle level of well-being (n=387)	Lowest level of well-being (n=315)	Total (N=960)
Average cultivated area per family (plazas)[1]	4.5	3.1	1.6	3.0
Percent families who do not have black soils**	42	47	55	48
Percent families who consider all their plots too steep to plough*****	10	26	31	23
Percent families having sown pastures*****	36	16	4	17
Percent families having natural pastures*****	54	36	24	37
Percent families having land in fallow***	64	54	47	54
Percent families having natural forest*****	47	34	18	32
Percent families owning cattle*****	37	13	1	16
Percent families having watersprings in their farm	45	49	38	44

[1] The averages are pair-wise significantly different at 0.5 level (Scheffe test).
** The frequency is significantly different at 0.01 level (chi-square test).
*** The frequency is significantly different at 0.001 level (chi-square test).
***** The frequency is significantly different at 0.00001 level (chi-square test).

Table 2. Use of fertilizers by well-being category
Percent households per category using

	Highest level of well-being (n=258)	Middle level of well-being (n=373)	Lowest level of well-being (n=315)	Total (N=960)
Organic fertilizers only (gallinaza)	48	44	36	41
Chemical fertilizers only	11	14	13	13
Both	38	27	16	26
No fertilizers	3	15	38	20

Frequency distribution is significant at 0.00001 level (chi-square test).

Table 3. Uses for household (and crop) residues by well-being category
Percent households per category

	Highest level of well-being (n=258)	Middle level of well-being (n=387)	Lowest level of well-being (n=315)	Total (N=960)
Making compost	30	28	23	27
Using it as green manure	57	63	67	63
Incorporating it*	6	3	3	4
Throwing it into the ditch (caño)	5	6	7	6
Using it to fill up the terrain*	6	6	2	5
Burning it*	14	12	7	11
Other	2	1	1	1
Nothing	4	1	1	2

* Frequency significantly different at 0.05 level (Chi-square test)

Table 4. Access to natural resources by altitude zone

	Low zone (n=331)	Middle zone (n=350)	High zone (n=386)	Total (N=1067)
Average cultivated area per family (plazas)[1]	3.3	2.8	2.8	2.9
Percent families who do not have black soils*****	51	62	37	50
Percent families who consider all their plots too steep to plough***	16	24	29	23
Percent families having sown pastures***	22	17	12	17
Percent families having natural pastures***	43	28	35	35
Percent families having land in fallow*****	62	42	54	53
Percent families having natural forest*****	40	27	25	30
Percent families owning cattle	16	11	16	14
Percent families having watersprings in their farm	43	44	42	43

[1] The average for the low zone is significantly higher from the middle and high zone at 0.5 level (Scheffe test).
*** The frequency is significantly different at 0.001 level (chi-square test).
***** The frequency is significantly different at 0.00001 level (chi-square test).

Table 5. Use of fertilizers by altitude zone
Percent households per zone using

	Low zone (n=331)	Middle zone (n=350)	High zone (n=386)	Total (N=1067)
Organic fertilizers only (gallinaza)	46	40	33	40
Chemical fertilizers only	11	13	14	13
Both	26	28	23	26
No fertilizers	16	19	30	22

Frequency distribution is significant at 0.0001 level (chi-square test).

Table 6. Uses for household (and crop) residues by altitude zone
Percent households per zone

	Low zone (n=339)	Middle zone (n=373)	High zone (n=392)	Total (N=1104)
Making compost	26	26	27	27
Using it as green manure	60	60	61	60
Incorporating it	5	4	4	4
Throwing it into the ditch (caño)***	9	2	8	6
Using it to fill up the terrain**	6	7	2	5
Burning it*****	6	19	10	12
Other*	2	0	1	1
Nothing	4	1	1	2

* Frequency significantly different at 0.05 level (chi-square test)
** Frequency significantly different at 0.01 level (chi-square test)
*** Frequency significantly different at 0.001 level (chi-square test)
***** Frequency significantly different at 0.00001 level (chi-square test)

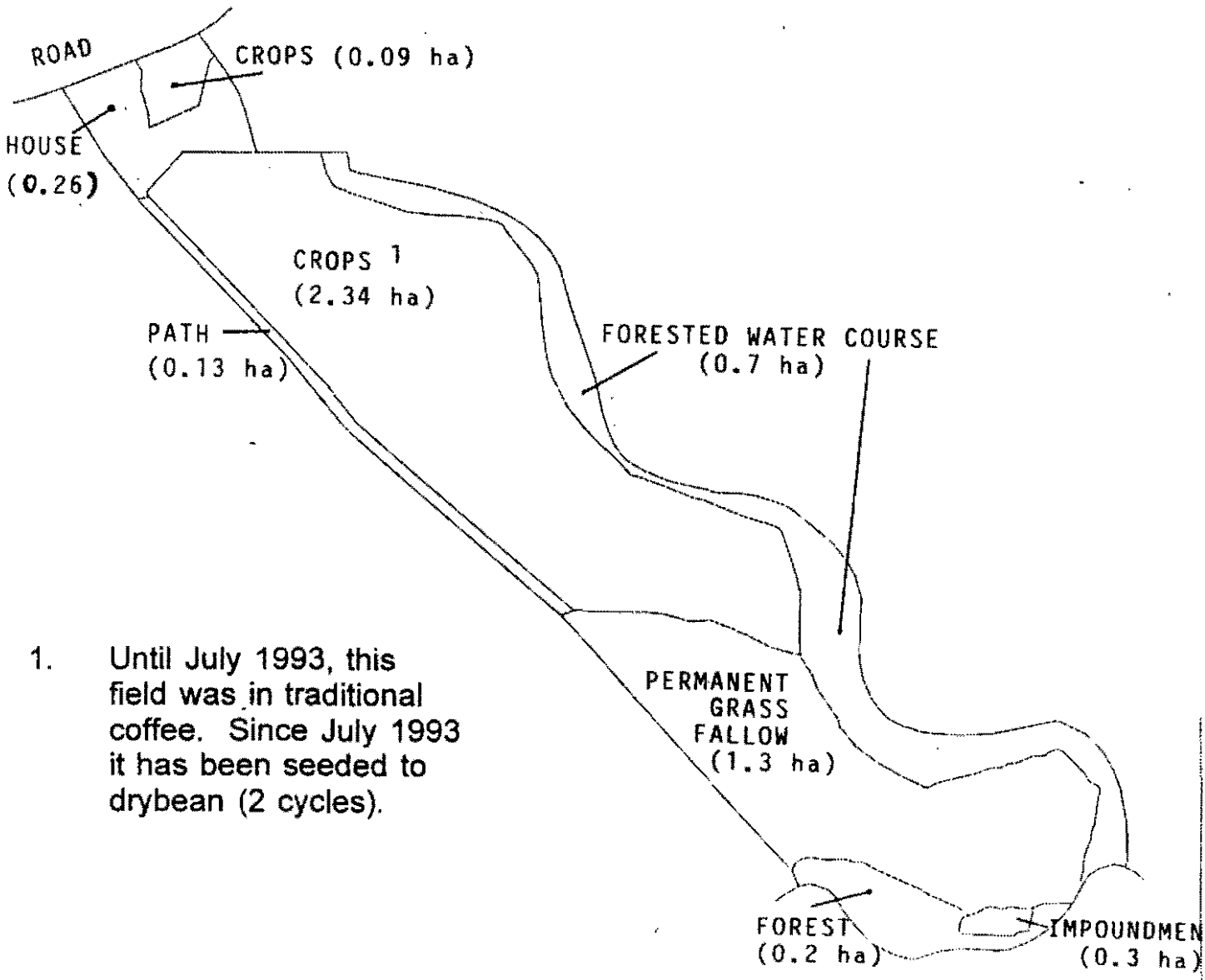
FARM MODELLING

HIERARCHAL SYSTEM CHARACTERIZATION OF CAUCA, COLOMBIA RESEARCH SITE

	Río Ovejas	Río Cabuyal	José Domingo farm
Elevation (m):	(%)	(%)	
1100 < 1500	24	21	-
1500 - 2000	39	69	1650 m
> 2000	37	10	
Soil:			
Pescador	15	43	*
Suarez	11	16	
Usenda	14	27	
Farallones	5	13	
Slope:			
0 - 10	na	38	*
10 - 50	na	52	*
> 50	na	10	*

JOSE DOMINGO FARM (5.2 ha)

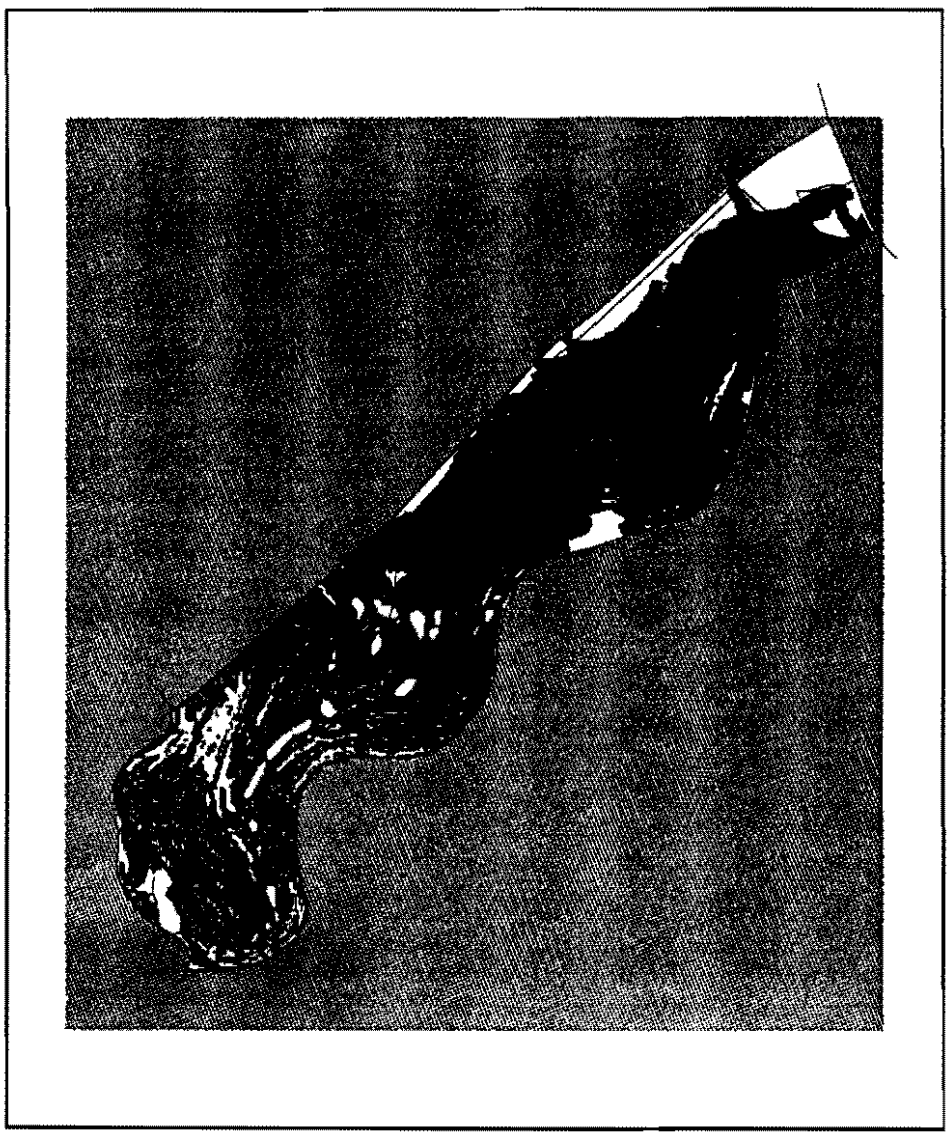
LAND USE MAP



1. Until July 1993, this field was in traditional coffee. Since July 1993 it has been seeded to drybean (2 cycles).

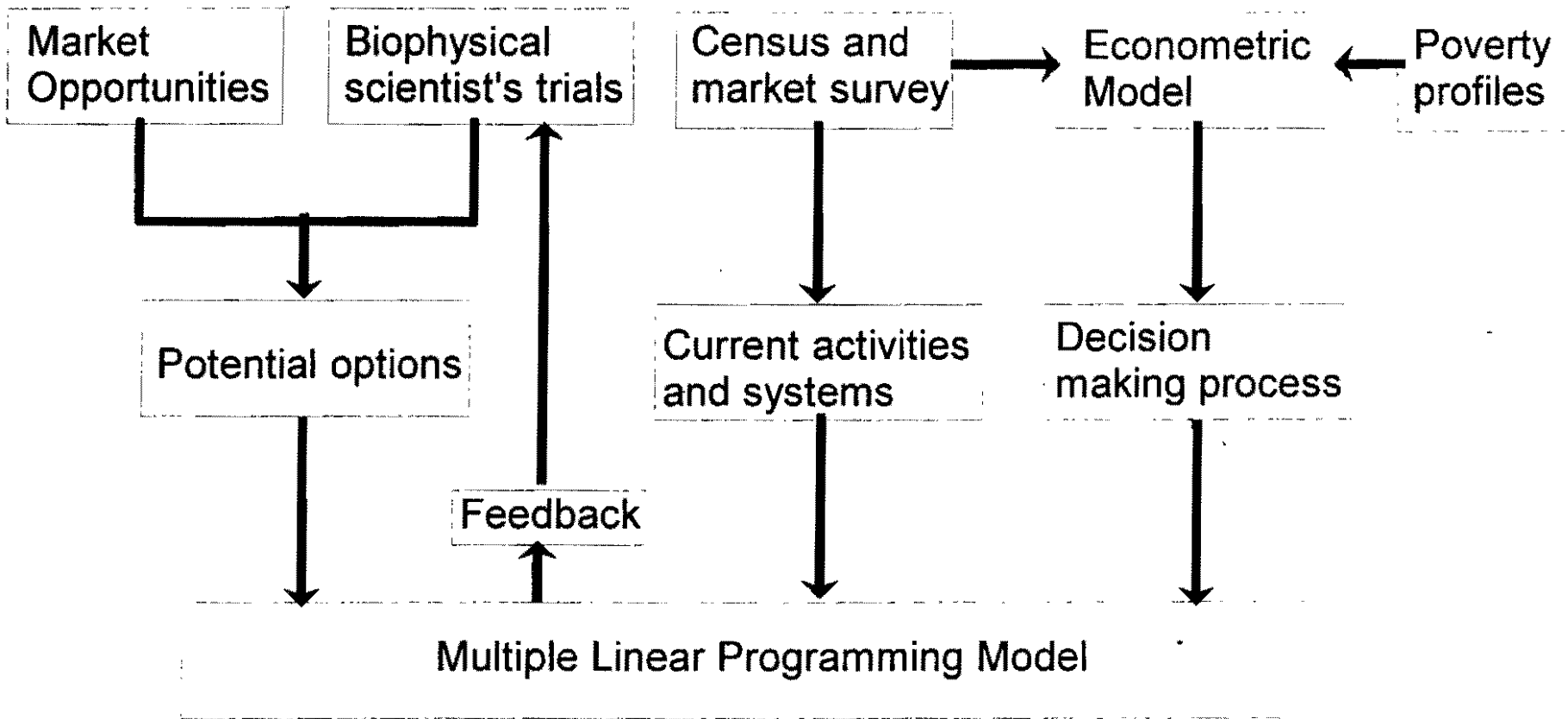
Jose Domingo Farm

Slope Classes



- 0% - 10%
- 10% - 20%
- 20% - 30%
- 30% - 40%
- 40% - 50%
- 50% - 60%
- 60% - 70%

The overall approach



Decision-Making process for the use of sustainable practices

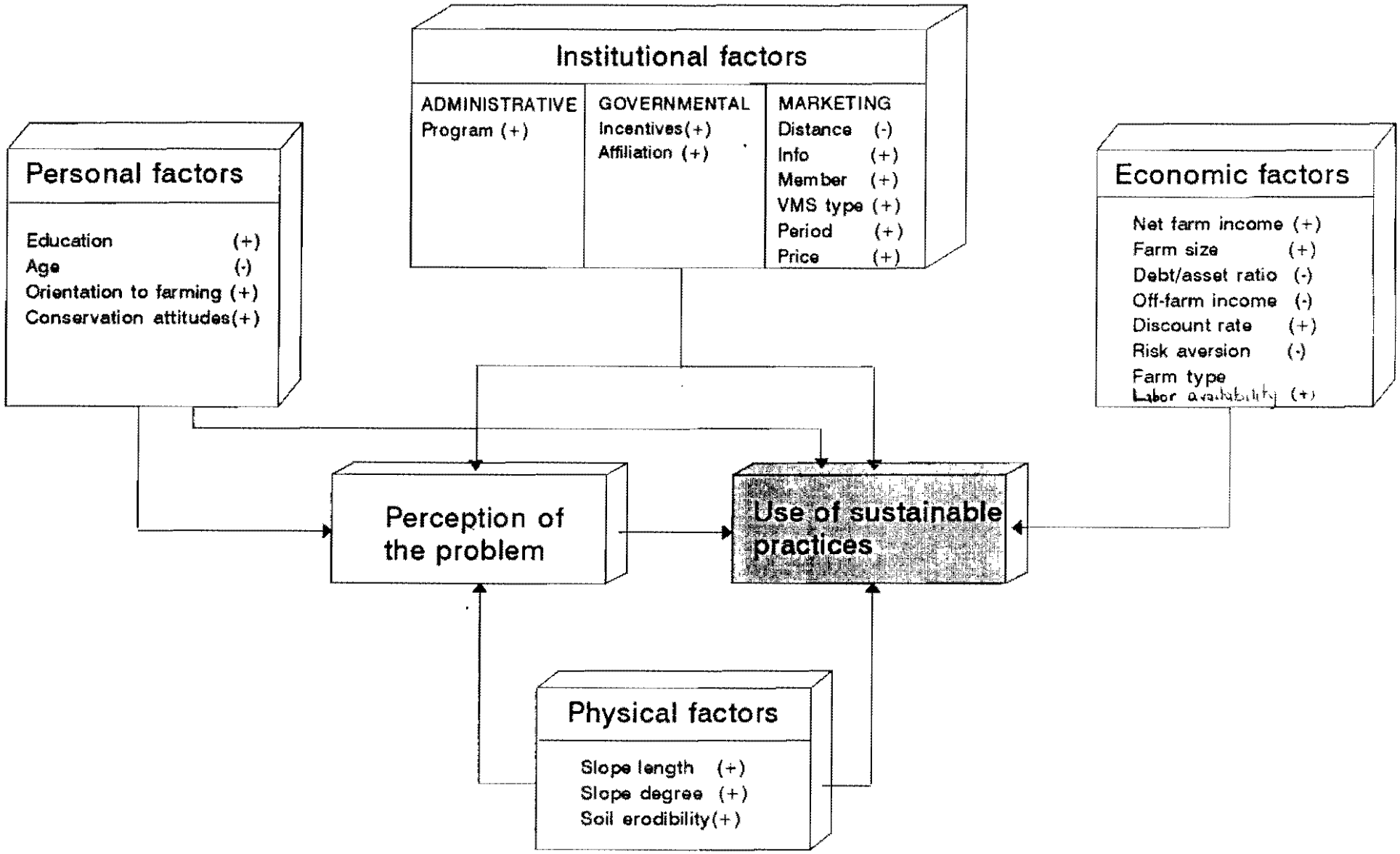
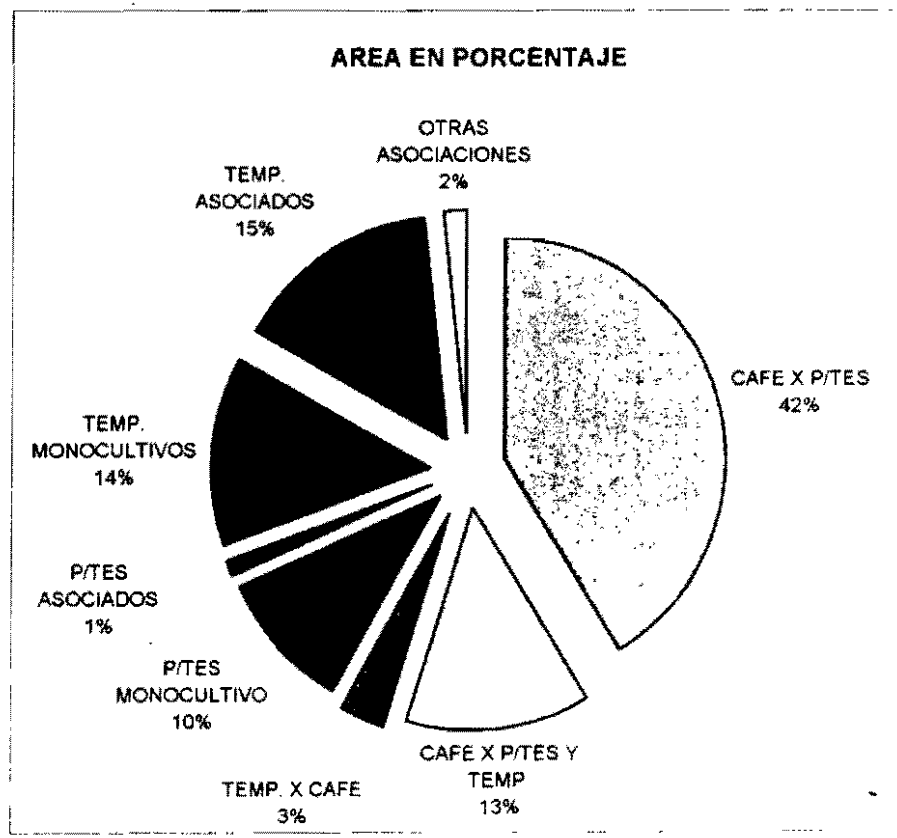


TABLA 2. Sistemas de cultivo diferenciados al interior de la subcuenca del rio Cabuyal Cauca - Caldono

SISTEMA	FRECUENCIA	AREA (plazas)	DIVERSIDAD	COBERTURA
cafe/platano	332.00	439.72	0.33	0.2
yuca	306.00	302.58	0.16	0.8
cafe/platano/frutas	156.00	211.84	0.5	0.2
cafe	148.00	183.26	0.16	0.3
cafe/platano/frutas/piña	120.00	181.5	0.66	0.1
pasto	124.00	181.3	0.16	0.05
yuca/frijol	111.00	158.52	0.33	0.8
café/platano/frutas/piña/1o2*	87.00	132.91	0.9	0.1
cafe/ 4 o 5	68.00	102.14	0.9	0.1
café/platano/piña	71.00	89.78	0.5	0.2
cafe/pl/1-(frutas o piña)	69.00	88.98	0.5	0.2
3 o 5/-(café)	70.00	88.7	0.75	0.5
caña	97.00	74	0.83	0.3
yuca/maiz	54.00	73.2	0.33	0.8
café/platano/yuca/1	34.00	71.08	0.66	0.3
café/platano/2	54.00	66.28	0.66	0.2
yuca/frijol/maiz	52.00	64.31	0.5	0.7
yuca/1 o 2	55.00	57.67	0.4	0.7
frijol	41.00	44.16	0.16	0.8
frijol/maiz	44.00	42.7	0.33	0.7
otras asociaciones	44.00	38.96	0.5	0.5
platano o frutas	53.00	38.54	0.16	0.1
2 o 3 permanentes/-(café)	35.00	36	0.58	0.1
maiz	54.00	35	0.16	0.4
cafe/frutas	38.00	34.23	0.33	0.2
café/frutas/piña	25.00	32.16	0.5	0.2
tomate	60.00	27.75	0.16	0.8
cabuya	20.00	22.5	0.16	0.5
café/2 o 3	15.00	21	0.55	0.3
maiz/1 o 2	25.00	20.88	0.4	0.7
café/otro permanentes	18.00	20.09	0.33	0.3
frijol/yuca	11.00	18.45	0.33	0.7
otro monocultivo	35.00	16.71	0.16	0.5
café/1 o 2 temporales	16.00	14.69	0.4	0.3
frijol/1 o 2	11.00	12.8	0.4	0.7
yuca o frijol o maiz/café	10.00	12	0.33	0.4
maiz/frijol	21.00	11.4	0.33	0.7
otro temporal/1 asociado	30.00	10.44	0.33	0.7
frijol/maiz/yuca	6.00	7	0.5	0.7
1 o 2 /café	8.00	3.58	0.4	0.4

CLASIFICACION DE LOS SISTEMAS DE LOTES REPORTADOS EN EL CENSO DE LA SUBCUENCA DEL RIO CABUYAL

TIPO DE SISTEMA	No LOTES	%	AREA (Plazas)	%
CON CAFE				
CAFE X P/TES	977	37.00	1281.56	42.00
CAFE X P/TES Y TEMP.	274	10.43	408.1	13.21
TEMP. X CAFE	88	3.35	104.28	3.38
	1339	**50.95**	**1793.94**	**58.08**
SIN CAFE				
P/TES MONOCULTIVO	294	11.19	316.34	10.24
P/TES ASOCIADOS	35	1.33	36	1.17
TEMP. MONOCULTIVOS	496	18.87	426.2	13.80
TEMP. ASOCIADOS	390	15.00	470.93	15.00
OTRAS ASOCIACIONES	74	2.82	49.4	1.60
	1289	**49.05**	**1294.87**	**41.92**
TOTAL LOTES	**2628**	**100.00**	**3088.81**	**100.00**



Sample size - 162

Field	Reason	%
First field	Income	73.8
	Nearby home	9.8
	Consumption	5.7
	Better soil	4.1
	Plane field	4.1
	Other	4.1
Second field	Income	64.4
	Consumption	18.9
	Labor	5.4
	Soil	4.4.
	Nearby home	4.4
	Other	3.3

Main field	Coffee	Cassava	Beans	Maize	Plantains	Other
% Farmer	78	5	9	4	0.8	3.2
Good Soil	49.5	33.3	36.4	80	0	-
Fair Soil	45.3	66.7	63.6	20	100	-
Bad Soil	5.3	-	-	-	-	-
Oxen Prepared	0	33.3	64	73	0	-
Barriers	34	17	36	18	0	-
Trincho	2	0	0	0	0	-
Compost	5	0	0	0	0	-
Machete	43	17	27	18	100	-
Recoge Residuos	53	0	73	9	0	-
Field Slope	30.2	24	26.7	22	40	-
Soil depth	19.4	13.7	19.2	47	-	-

Other: Potato, tomato, pastures and blackberry with 0.8% each.

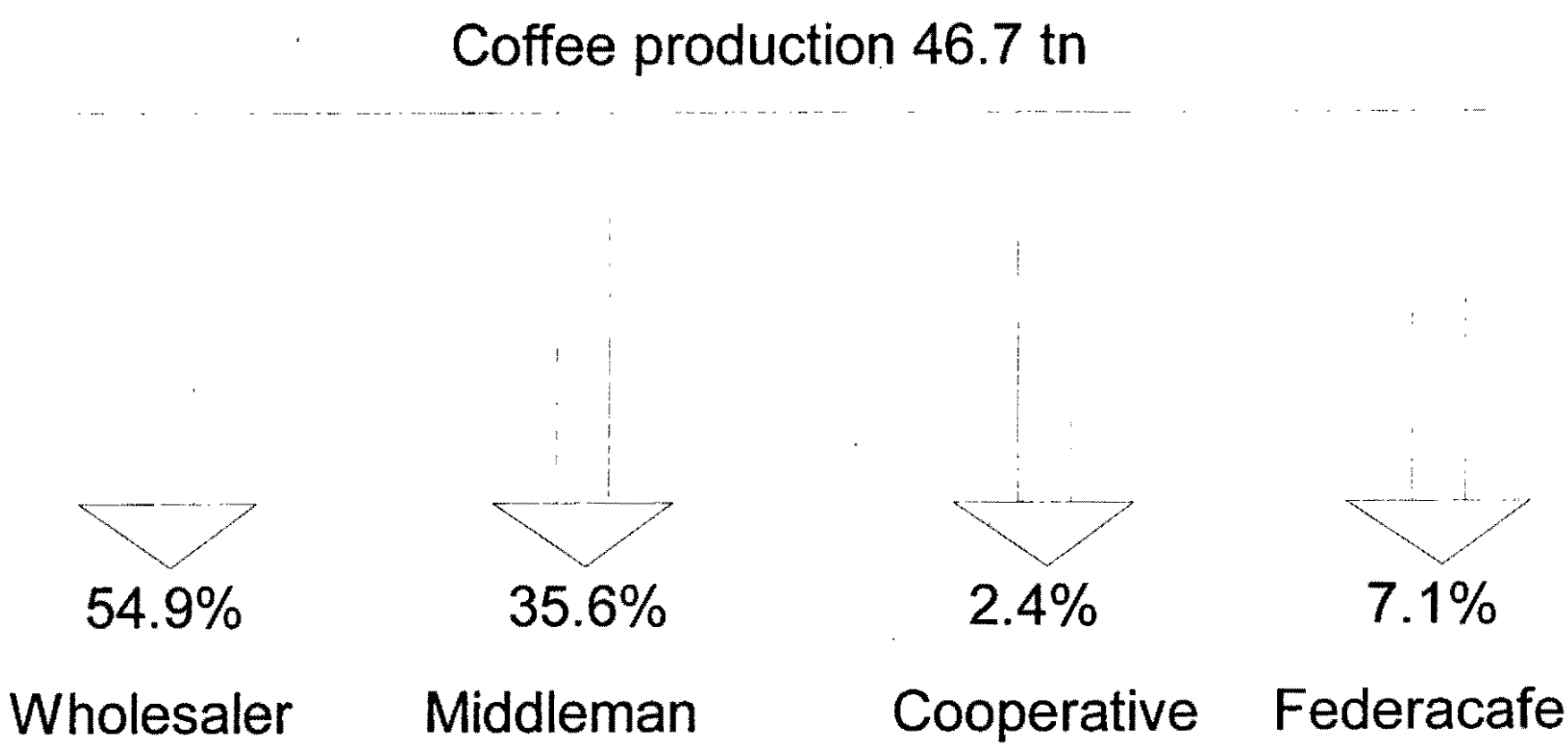
Reasons for changing buyer (%)

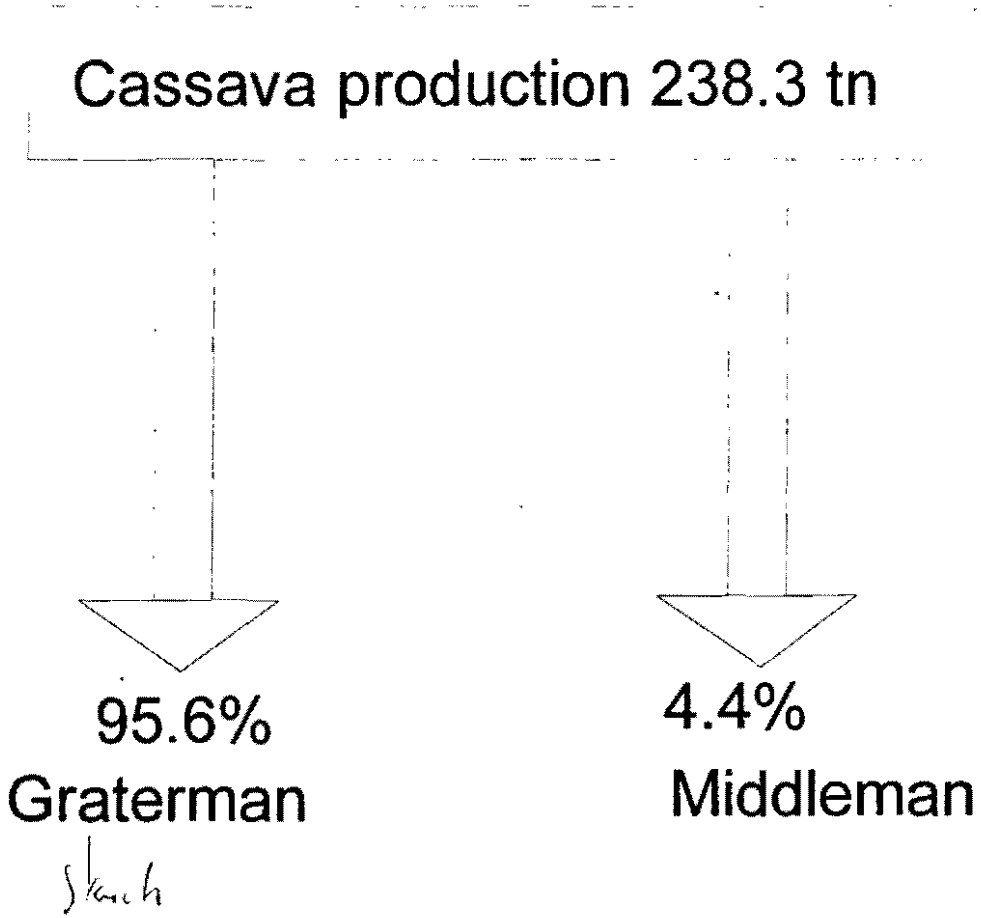
	Middleman	Wholesaler	Federacafe	Graterman	Other	Total
Fake Weights	51.3	5.3	10.5	2.6	-	66.1
Did not come back	40.8	6.6	2.6	4.3	6.5	60.8
No loans	6.6	2.7	10.5	-	-	12.0
Total	98.7	9.3	18.4	5.2	6.5	93.5

62% out of the farmers have changed buyer at least once.
60.5% are middlemen mainly because of fake weights and secondly because of their high unstability.

	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
Production (@)	1531	1549.2	306.4	3386.6
Sale (%)	72	83.4	80.8	78.0
Consumption (%)	11.6	11.9	18.4	12.4
Seed or other (%)	16.4	4.7	0.8	9.6
Cassava				
Production (@)	7496	9155	2242.1	18893.1
Sale (%)	98.5	98.3	97.5	98.3
Consumption (%)	1.1	1.1	1.8	1.2
Seed or other (%)	0.4	0.6	0.7	0.5

	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
Production (@)	649	2113.6	631	3393.6
Sale (%)	52.5	81.8	92	78.1
Consumption (%)	31	8	7.5	12.3
Seed or other (%)	16.5	10.2	0.5	9.6
Cassava				
Production (@)	3117.9	10793.2	4992.5	18903.6
Sale (%)	96.1	99	97.8	98.2
Consumption (%)	0.3	0.5	1.4	0.7
Seed or other (%)	3.6	0.5	0.8	1.1


Coffee production 46.7 tn
54.9%
Wholesaler
35.6%
Middleman
2.4%
Cooperative
7.1%
Federacafe


Cassava production 238.3 tn
95.6%
Graterman
4.4%
Middleman

LAND USE TYPES

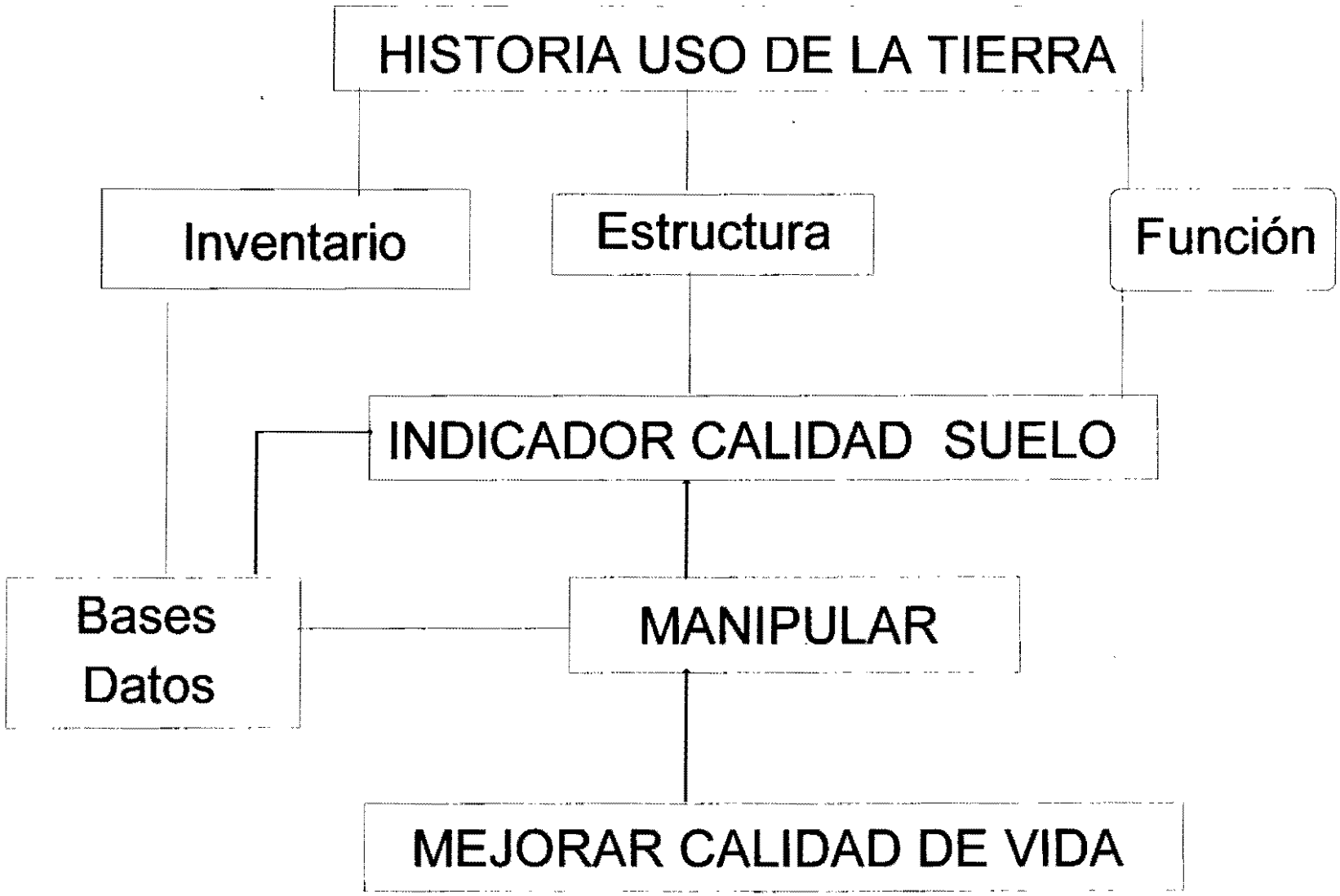
(Soil quality classes)

BIOPHYSICAL CHARACTERIZATION OF A RANGE OF LAND USE TYPES FOUND IN THE RIO CABUYAL WATERSHED

	40 yr secondary forest	Woodlots	Pasture/ bean 1yr	Traditional coffee	Bean/ Fallow	Yuca/ Fallow 2yr
SOIL PHYSICAL PROPERTIES:						
Non-limiting soil moisture (mm/m)	na	na	123	152	na	187
Bulk Density	na	na	0.82	0.47	na	0.50
BIODIVERSITY:						
Taxonomic units	27	15	8	17	na	15
SOIL CHEMICAL PROPERTIES:						
pH	4.5	4.5	na	5.2	na	5.5
Organic C (%)	4.0	3.5	na	6.9	na	6.7
Base saturation (%)	36	22	na	61	na	73
YIELDS: (Total potential one year production: kg/ha)						
Bean	3152	3974	na	5928	na	5884
Maize	6529	9358	9077	8059	9115	14010

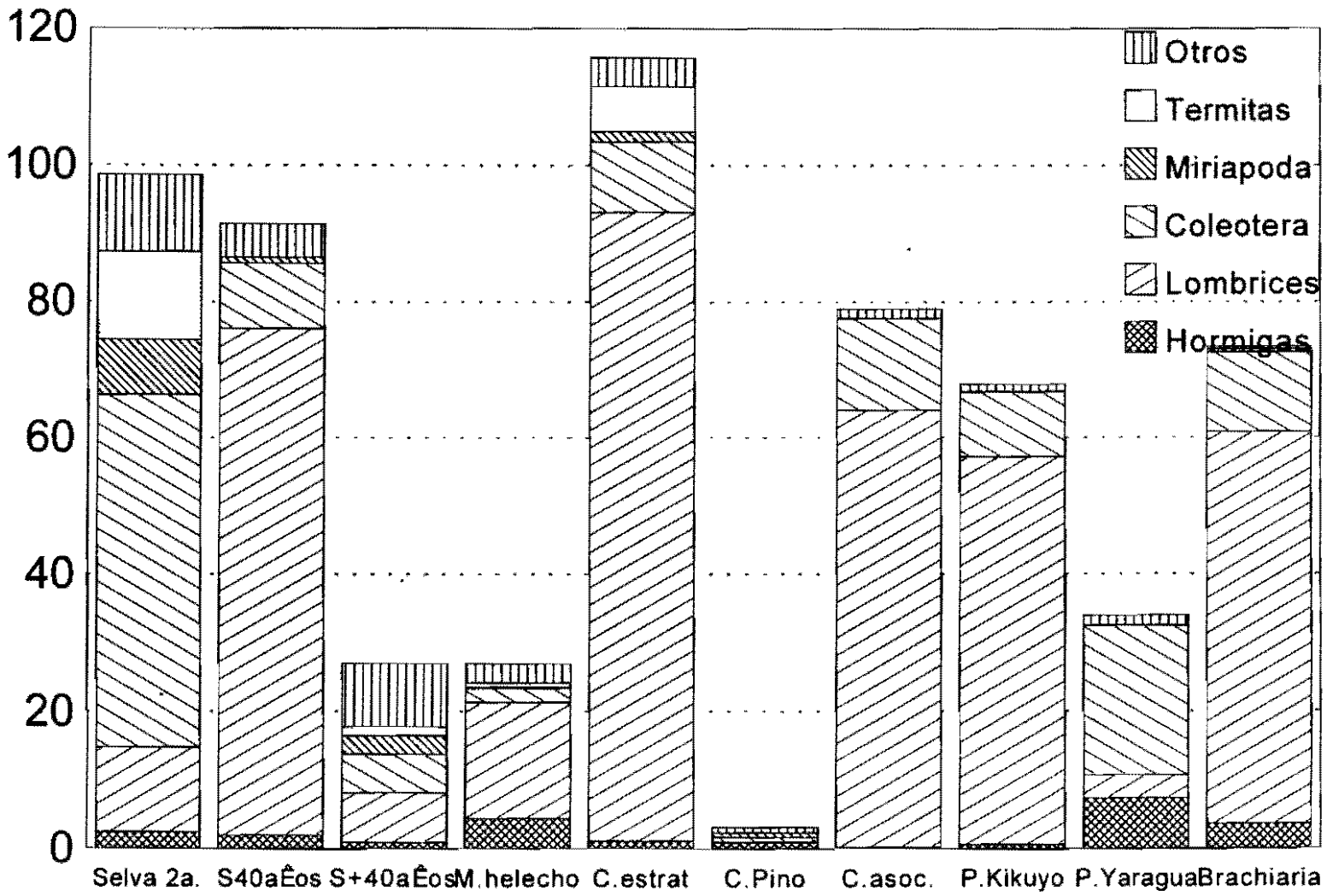
Asociación	Conjuntos	Localización	Profundidad	Textura	Color superficie	ph
Asnm/Geomorfología Farallones 2000 - 3000 msnm FR Taludes de planos intramontanos de clima frío humedo	Farallones typic humitropept lebala andic humi tropept	Arcas de relieve escarpado con pediente fuertes Onduladas con zona de acumulación	Superficiales a moderadamente prof. 0-30 30-70 Profundidades 0-50 50-80	Text franco finas Far a finas Fargr Far finas Ar	Color pardo oscuro Pardo grisaceo oscuro	5-3 - 5-7 5-4 - 5-5
Pescador PD < 1800 Altiplanos directados de clima 1/2 humedo	Pescador Oxio Dystropept Dinde Typic Dystrandept Rosario Entic Dystrandept Estación Andic Humitropept	Flancos 1/2 de altiplanos disectados de clima medio humedo Ondulaciones avances y zonas de acumulación en los mismos altiplanos directados En flancos y cimas del mismo paisaje Flancos de mayor pendiente en el mismo paisaje	Prof. a muy pref. 0-25 25-43 Muy prof. 0-45 a 5-60 Prof. a muy prof 0-15 15-40 Prof a muy prof. 0-30 30-50	Medias a finas F F Medias a finas organica FA Medias a finas FA Despersa Moderadamente finas F Ar	Gris a muy oscura a pardo grisaceo muy oscuro Negro a pardo grisaceo muy oscuro Pardo muy oscuro a pardo oscuro Negro a gris muy oscuro	5-5 5-8 4-9 - 5-9 5-1 - 5-6 5-1 - 5-7
Suarez SM < 2000 Taludes abruptos de altiplanos directados de clima 1/2 humedo	Suarez Ustre Dytropept Minas Typic Dyastropept Pan de Azúcar Andic Dystropept	Relieve fuertemente quebrado con pendiente entre 25 y 50% Relieve fuetemente quebrado con pendiente del 45% aproximandamente Relieve fuertemente quebrado con pendientes complejas entre 25 - 50%	Profundas 0-40 / 40-60 Pref a muy prof 0-22 / 22-35 Muy. Profundas 0-35 / 35-48	Medias y gravillosas ArA FArGR Finas Ar Ar Finas FAr Ar	Gris muy oscuro Pardo oscuro Pardo grisaceo oscuro	5-0 - 5-2 4-4 - 5-1 5-0 - 5-3
USENDA 2000-3000 Planos intramontanos de clima frio humedo	Aguada Typic Dystrandept Usenda Typre Placandept Colorado Typic Dystropept	Flancos y cimas de las ondulaciones Planos humedos intramontanos Flancos de las ondulaciones	Pref a muy profundas 0-25 / 25-45 Moderadamente Profundas 1-10 / 10-30 Profundas 0-21 / 21-43	Francas gruesas a francas finas organica FA Finas organica FA Finas FAr ArL	Negro Pardo osucro Negro a gris muy oscuro	5-6 6-8 5-7 6-2 5-3 5-6
Puellenge PU Valle coluvio aluviales	Puelenge Tropic Fluvaquent Limonares Typre Ustropept	Pantanosos con influencia aluvial en valle estrechos	0-5 50-140 Superficial 0-60 60-100 Profundas	Fanca F F FAr Media FAr	Gris muy oscuro Pardo oscuro	5-7 5-8
ALSACIA Planicie directada baja	Alsacia Typic Placandept Morales Typre Dystrandept		0-10 Organico 10-38 organico 38-45 FA 0-20 organico 20-40 FA	Muy profunda Muy profunda	Negro Pardo grisaceo oscuro	5- 5-6 5-5 5-9

RELACIONES MACROFAUNA PERTURBACION Y FERTILIDAD DEL SUELO



INVENTARIO MICROCUENCA RIO CABUYAL

BIOMASA(g/m2.0.30) DE LA MACROFAUNA



S=SucesiÂn; S=de m s de 40; M=Matorral; C=Cultivo;Asoc.=Asociado; P=Pradera

Cuadro 1. Cluster de unidades taxonómicas y análisis de suelo para sitios con uso de tierra diferente de la Subcuenca del Río Cabuyal

No. Cluster	[illegible]	L	H	T	A	C Org. %	BIT meq/100g	CIC_e	S.B. %
1	Sucesión 40 Mat. Arbustivo. Cultivo.Estrat. C.Pino C.Asociado P.Brachiaria	339	1230	61	46	8.4	4.7	4.9	95.9
2	M.Helecho P.Kikuyo P.Yaragua	368	3575	33	25	12.5	1.3	2.9	44.8
3	Selva 2a.	210	1658	2734	587	15.5	9.7	9.3	104
1	Café + platano C. Asociado 2 Monocult. Yuca 2 Tomate	-	-	-	-	7.7	1.25	1.97	63
2	Sucesión 40 anos Sucesión +40 anos Frijol pasto	–	–	–	–	3.7	1.51	4.69	32

* L= Lombrices; H= Hormigas; Termitas; A= Aracnida

** BIT= Bases Intecambiables totales; C Org.= Carbono orgánico; CICe= Capacidad de intercambio catiónico; SB= saturación de bases

PROTOTYPE PRODUCTION SYSTEMS

JAA-PanField.wp

PROTOTYPE SYSTEMS FOR ECOLOGICALLY SOUND INTENSIFICATION OF PRODUCTION IN THE HILLSIDES

Purpose

To develop agrosilvopastoral systems that improve soil quality, water management, and the efficiency and productivity of labor.

Outputs

- Sustainable agrosilvopastoral systems
- Stable or improved soil quality
- Improved water management in hillsides
- Improved labor productivity and efficiency

Strategy

Transition from short cycle, shallow rooted monocrops to deep rooted, perennial more diverse agrosilvopastoral systems.

Hypotheses

Through perennial deep rooted systems:

- Improve quantity and quality of soil organic matter
- Hold soil in place
- Improve microbial activity
- Stabilize/increase soil fertility
- Have less variability, more security of income, cash flow

RESEARCH STRATEGY

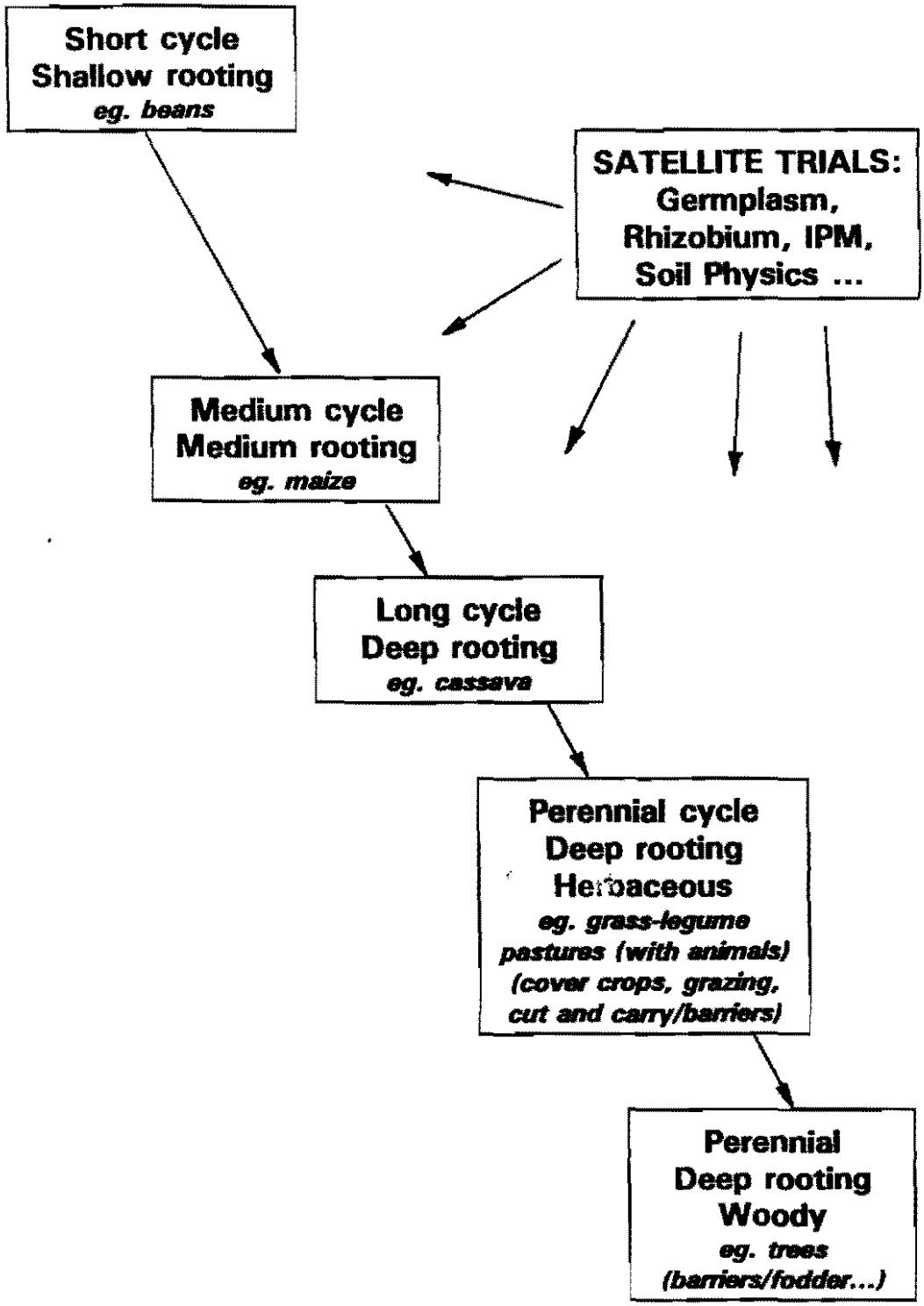
LONG-TERM RESEARCH TO ELUCIDATE PRINCIPLES TO GRADUALLY TRANSFORM FARMERS' DEPENDENCE ON MONOCROPPED/ INTERCROPPED SHORT SEASON ANNUALS INTO SYSTEMS WITH A MAJOR ROLE FOR PERENNIALS (GRASSES, LEGUMES, TREES).

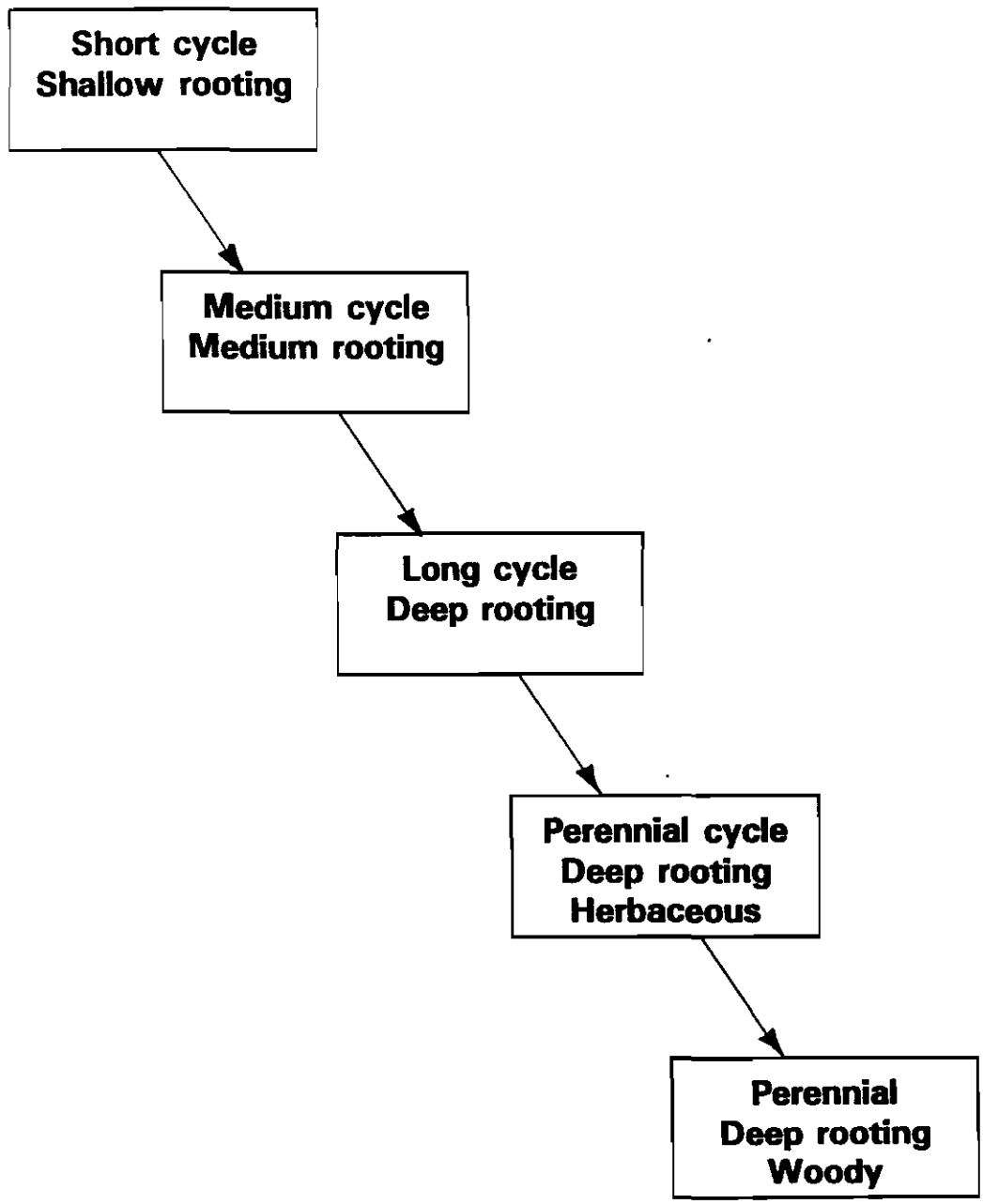
The strategy includes:

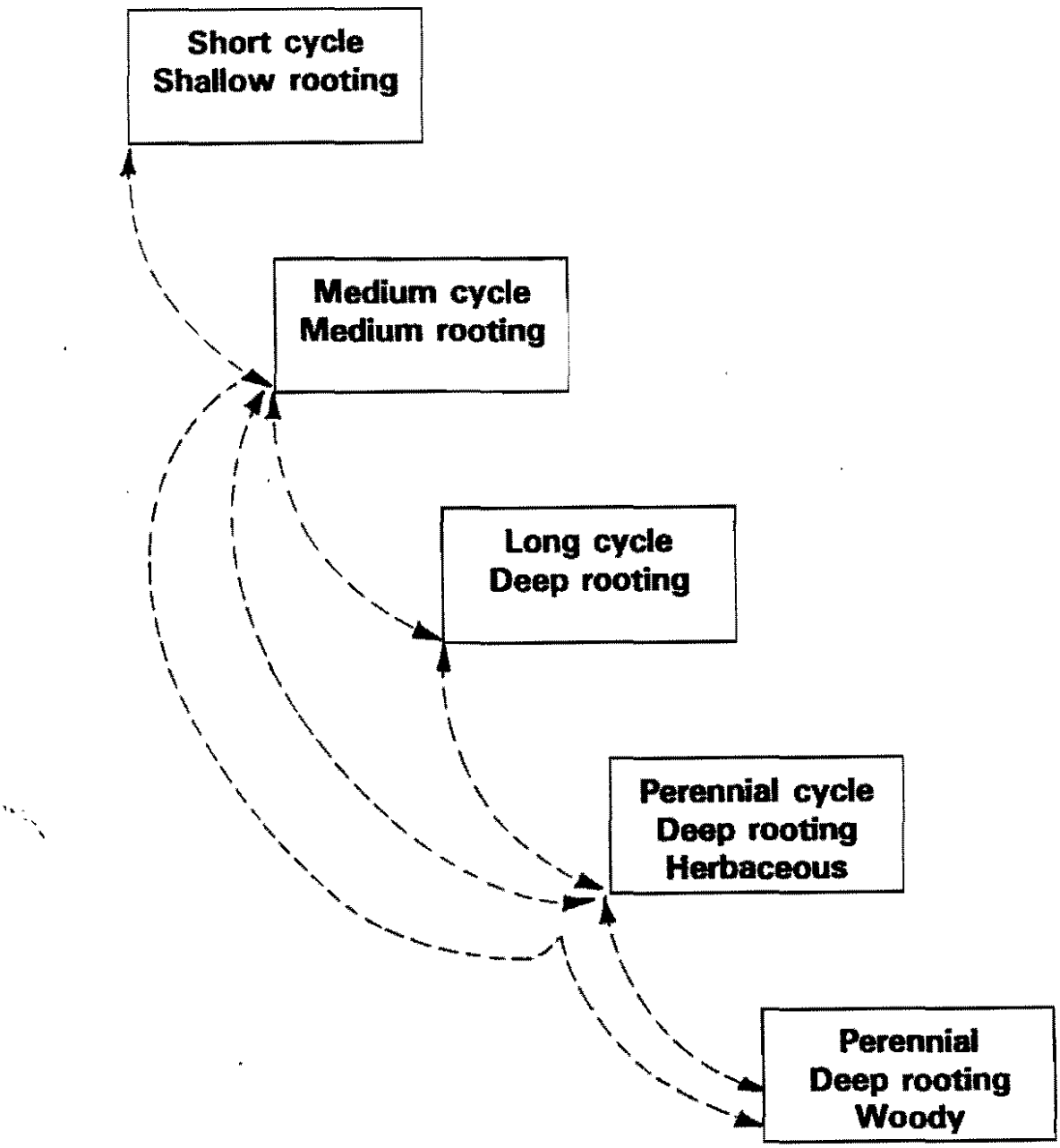
1. **Field prototype studies**

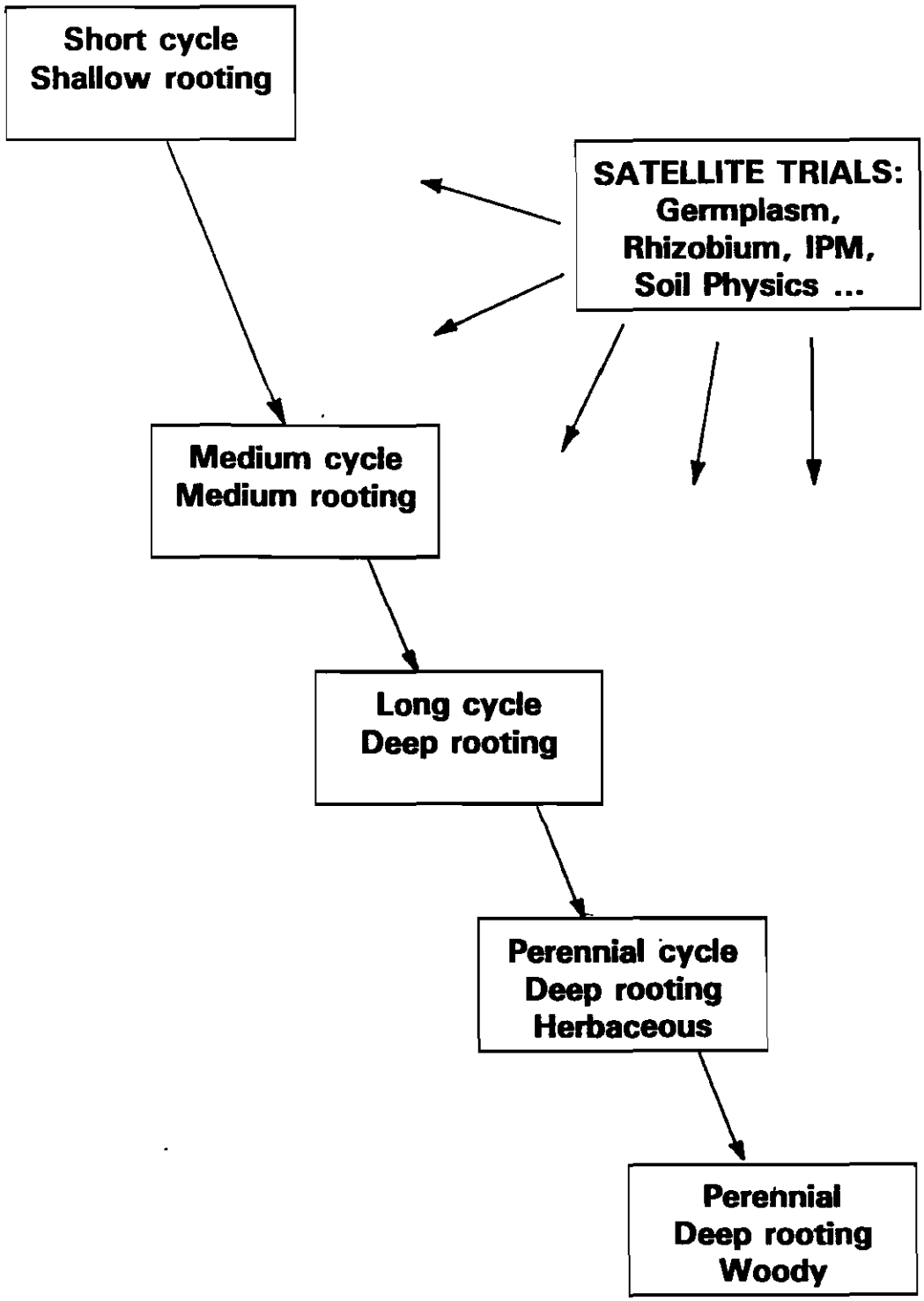
2. **Participatory/market oriented research**

1. Field prototype studies

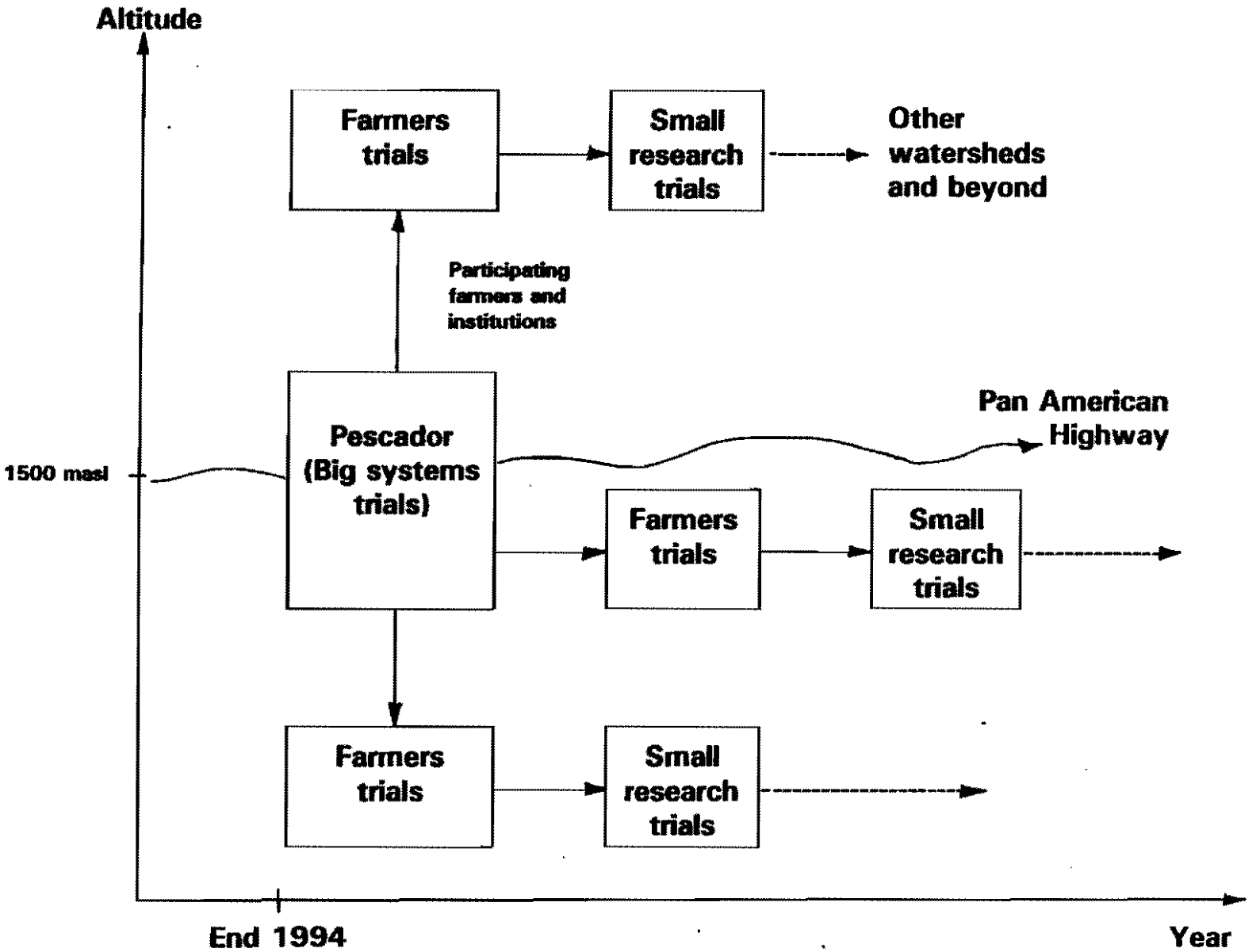



Short cycle
Shallow rooting
Medium cycle
Medium rooting
Long cycle
Deep rooting
Perennial cycle
Deep rooting
Herbaceous
Perennial
Deep rooting
Woody

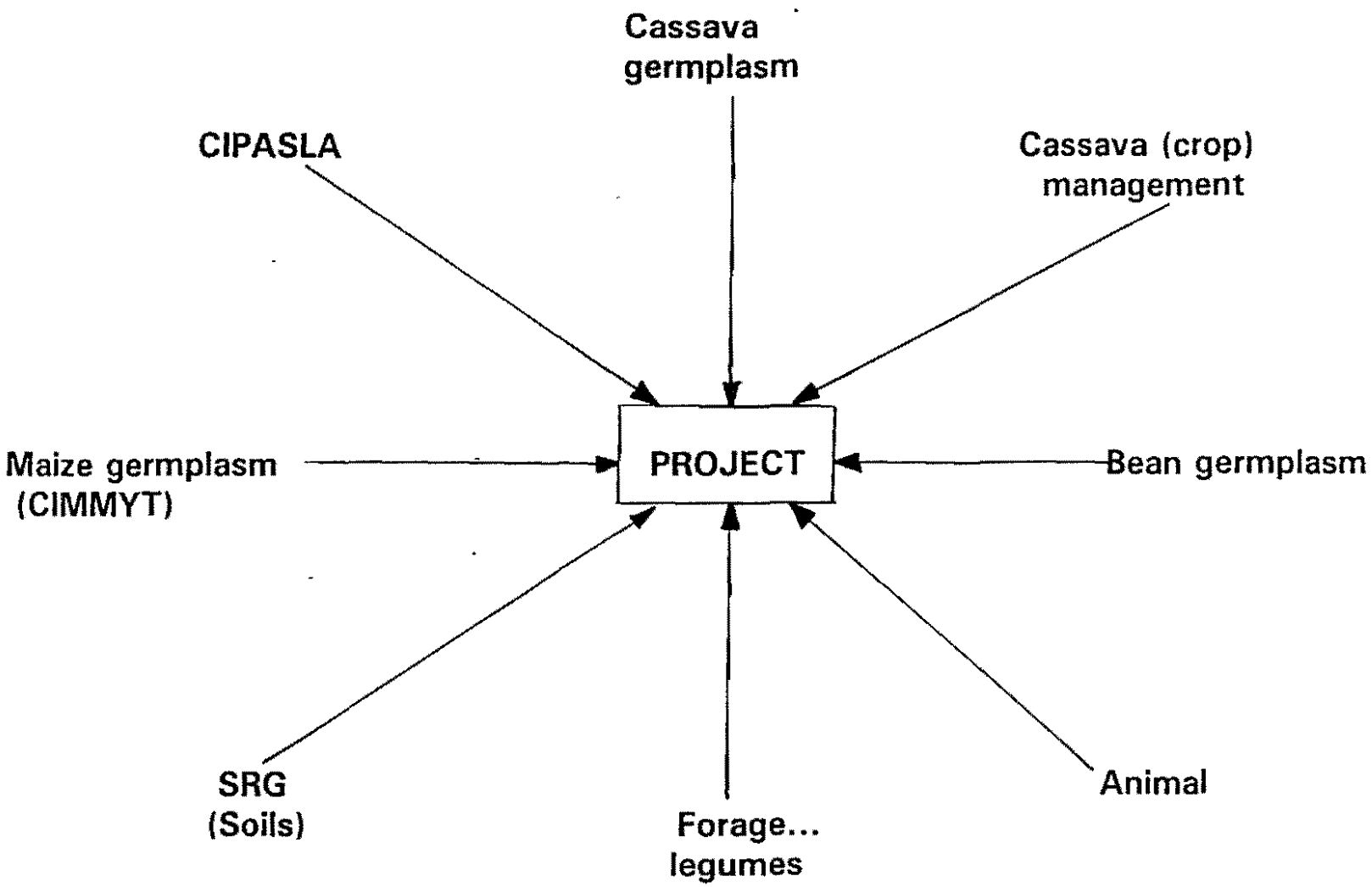

Short cycle
Shallow rooting
Medium cycle
Medium rooting
Long cycle
Deep rooting
Perennial cycle
Deep rooting
Herbaceous
Perennial
Deep rooting
Woody


Short cycle
Shallow rooting
SATELLITE TRIALS:
Germplasm,
Rhizobium, IPM,
Soil Physics ...
Medium cycle
Medium rooting
Long cycle
Deep rooting
Perennial cycle
Deep rooting
Herbaceous
Perennial
Deep rooting
Woody

2. *Participatory/market oriented research*



THE PROCESS: (Collaborators)



In the selected farms various alternatives from the following systems will be evaluated:

1. Monocrops: cassava, maize, beans, native pasture (for grazing).

2. Maize + legumes cocktail (green manure or forage) in two contrasting fallows (native grass and older fallow).

3. Maize + two grasses (separate) + legumes cocktail (for grazing) (to compare with 1 above).

4. Cassava + legumes cocktail (green manure or forage) in two contrasting fallows (as in 2 above).

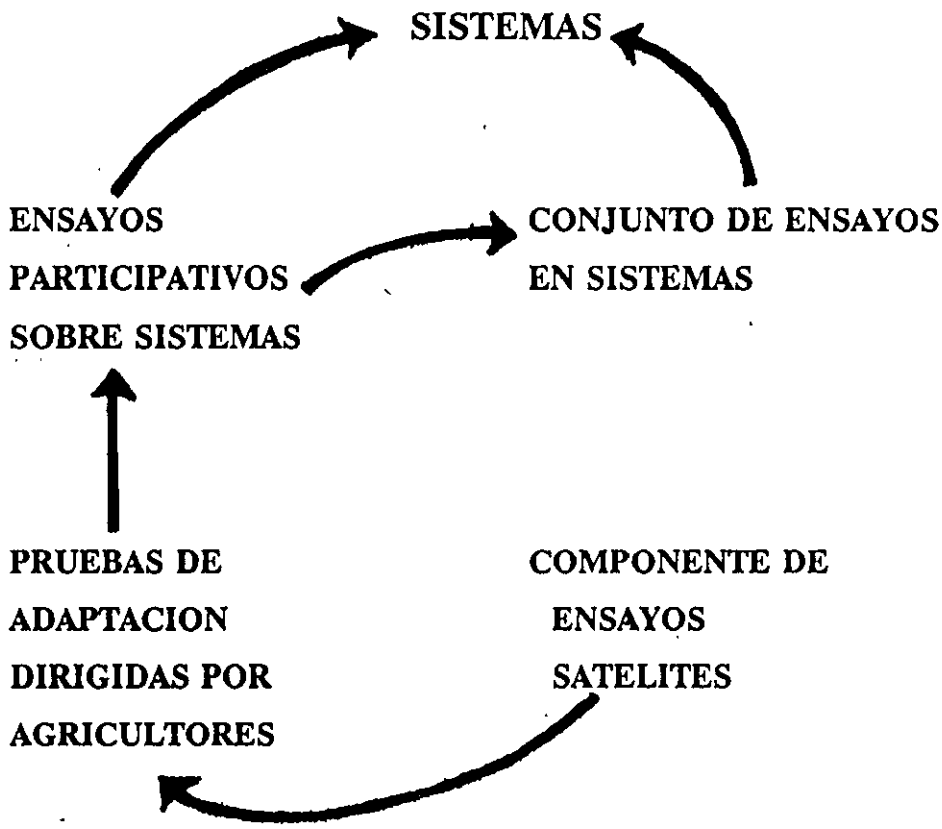
5. Crop rotation: beans, cassava, legumes.

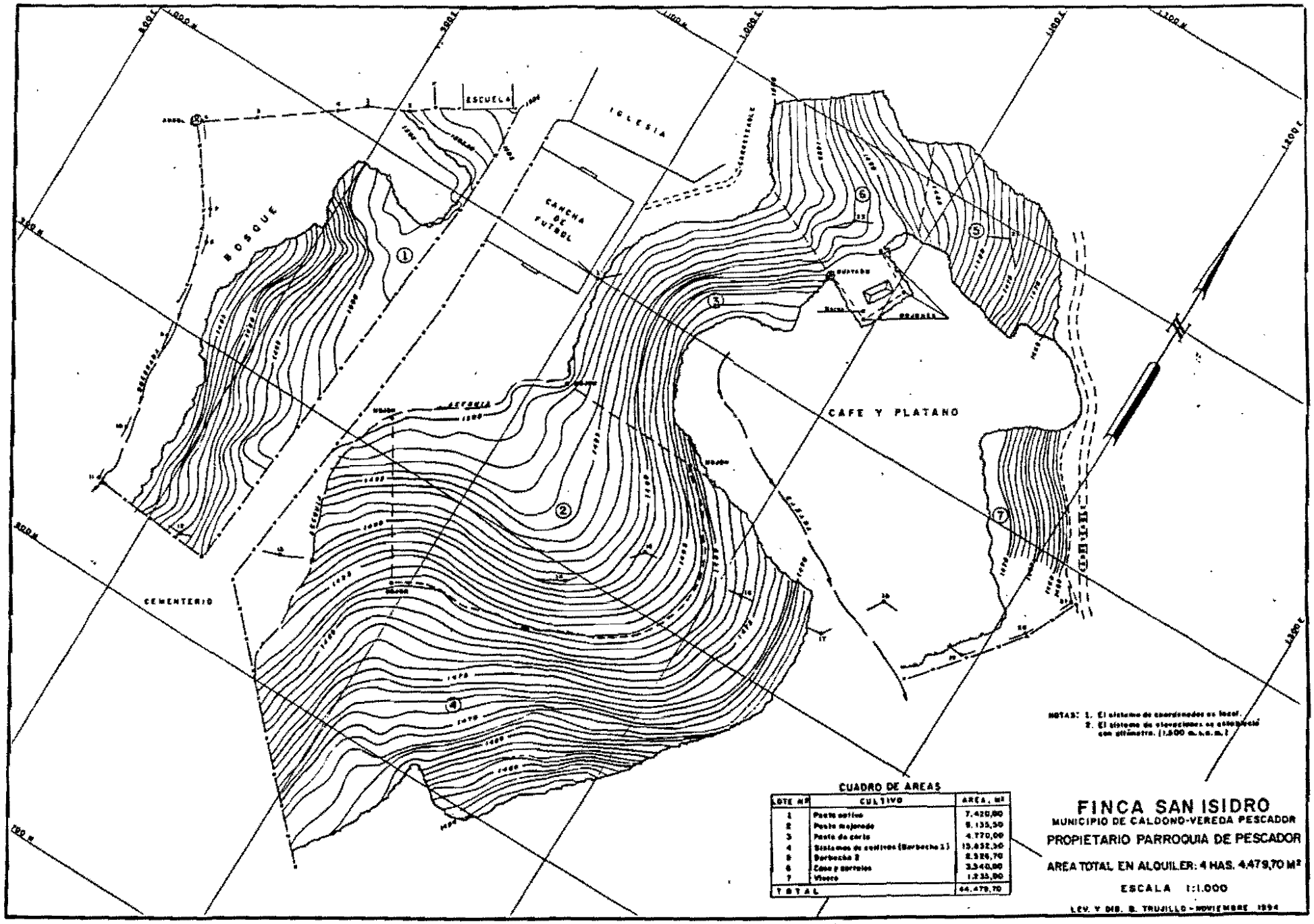
6. Barriers and field(s) perimeter(s) with: grasses, grasses + legumes, and grasses + legumes + trees.

7. Forage species on steep slopes: grasses, grasses + legumes, and grasses + legumes + trees.

These system trials will be established in two or more sites with varying conditions and with three replications in each site in full 1994.

NUEVAS TECNOLOGIAS PROTOTIP0





NOTAS: 1. El sistema de coordenadas es local.
2. El sistema de elevaciones es arbitrario con altímetro. (1.500 m.s.n.m.)

CUADRO DE AREAS

LOTE Nº	CULTIVO	AREA, M²
1	Pasto natural	7.420,80
2	Pasto mejorado	9.135,50
3	Pasto de corte	4.770,00
4	Sistemas de cultivos (Barbecho 1)	15.632,50
5	Barbecho 2	2.526,70
6	Caña y cercos	3.340,00
7	Viveros	1.235,80
TOTAL		44.479,70

FINCA SAN ISIDRO

MUNICIPIO DE CALDONO-VEREDA PESCADOR

PROPIETARIO PARROQUIA DE PESCADOR

AREA TOTAL EN ALQUILER: 4 HAS. 4.479,70 M²

ESCALA 1:1.000

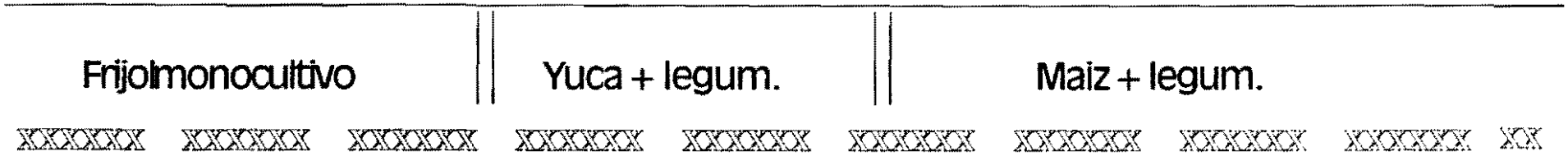
LEV. Y DIB. B. TRUJILLO - NOVIEMBRE 1994

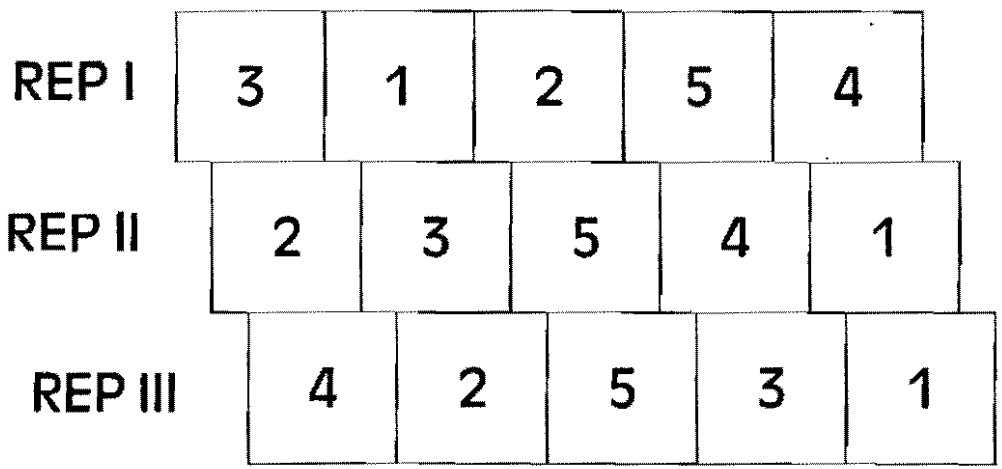
LOTE: Junta Parroquial **VEREDA:** : Pescador

MUNICIPIO: : Caldono

SIEMBRA YUCA: Nov 15/94

A.S.N.M.: 1500 m





REP IV

2	1	5	4	3

1. SG-427-87
2. SM-524-1
3. MCOL-2261
4. MCOL-2061
5. CG-402-11

LOTE: Junta Parroquial

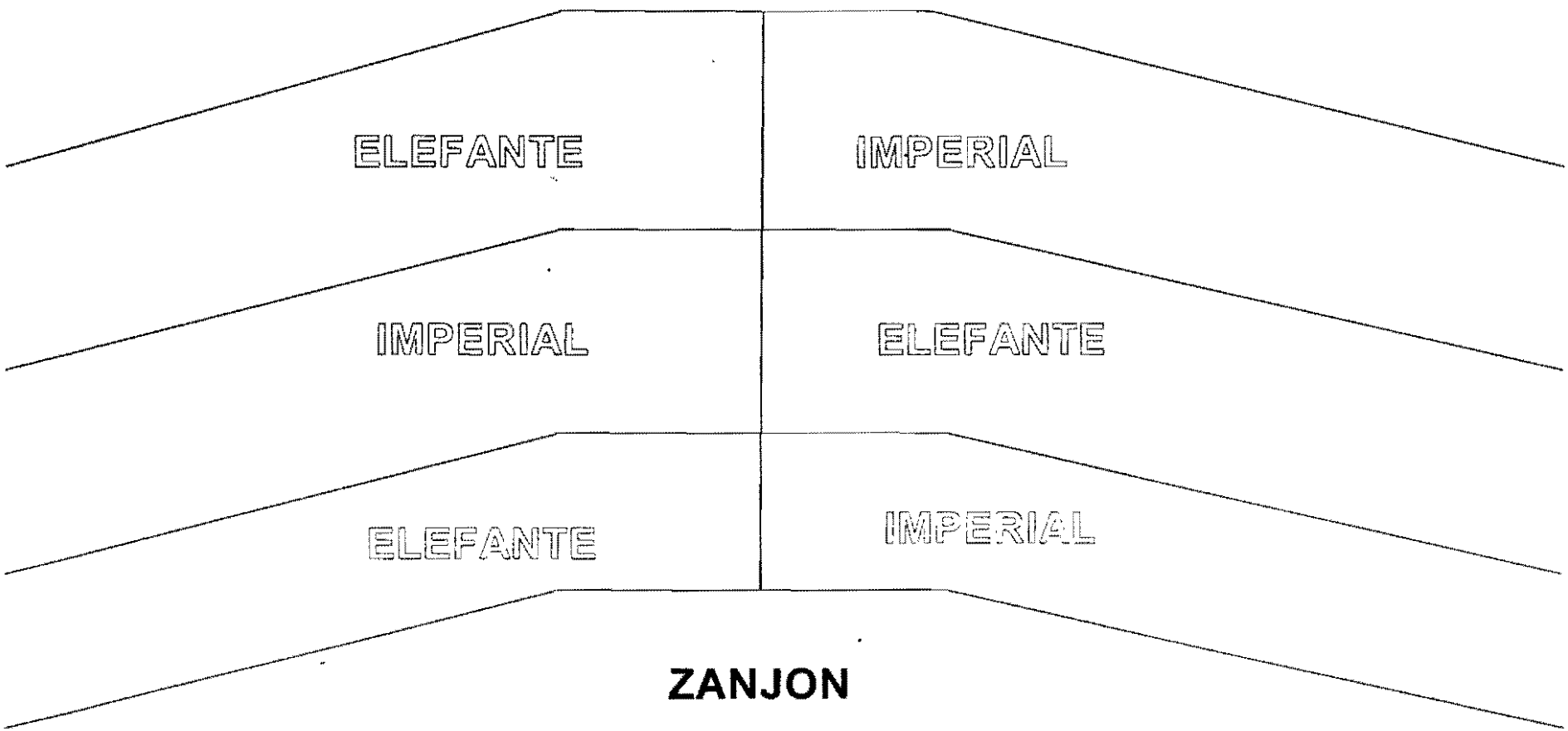
VEREDA: : Pescador

MUNICIPIO: : Caldono

SIEMBRA YUCA: Nov 15/94

A.S.N.M.: 1500 m

CANCHA DE FUTBOL



LOTE: Junta Parroquial **VEREDA:** : Pescador

S. PRODUCCION: OCT 25 A 3 NOV/94 ***MUNICIPIO:*** : Caldono

AREA DE PARCELA: 400 M ***A.S.N.M.:*** 1500 m

MAIZ/PASTO/LEGUMINOSAS

CANA DE AZUCAR — PINA — ELEFANTE ENANO — IMPERIAL

G	A	D	E	F	C	B
EROSION	YUCA	MAIZ LEGUM.	YUCA LEGUM.	YUCA MAIZ FRIJOL	FRIJOL	MAIZ

ELEFANTE ENANO — PINA — CANA DE AZUCAR — IMPERIAL

A	E	C	B	F	G	D

IMPERIAL — ELEFANTE ENANO — PINA — CANA DE AZUCAR

F	C	E	D	G	A	B

XXXXXXXXXX XXXXXXXXXX XXXXXXXXXX — CITRONELLA

VARIEDADES DE YUCA

LOTE: Junta Parroquial **VEREDA:** Pescador

S. PRODUCCION: OCT 25 A 3 NOV/94 ***MUNICIPIO:*** Caldono

AREA DE PARCELA: ***A.S.N.M.:*** 1500 m

BARBECHO 2: Lote de 2 anos en descanso

CITRONELA

D MAIZ LEGUMINOSA	E YUCA LEGUMINOSA
D	E
E	D

CASA

CAFETAL

CANA BRAVA

LEGUMINOSAS

Managing Organic Matter in Agrosilvopastoral Systems that Combine Soil Conservation and Production Technologies for the Low-, Mid- and High-Altitude Andean and Central American Hillsides.

(A project under development)

A "Planning by Objectives" exercise carried out by a multidisciplinary group of CIAT scientists identified the deterioration of soil quality, as reflected in soil erosion, fertility decline and decreased nutrient regeneration, as one of the major problem areas in the Andean hillsides. Soil organic matter (SOM) is a critical component in maintaining or building up soil quality, due to its capacity to regulate nutrient cycling and improve the soil physical structure, and its role in the biological food web (Figure 1). Research on organic matter therefore is the key to understanding the interaction between soil physicochemical processes and plant production, and explain why certain land management systems perform well and others degrade. It brings together information from other soil-related disciplines, thus adding to an integrated understanding of soil processes in hillsides' agroecosystems.This is a prerequisite for developing sustainable land management practices for the hillsides and being able to extrapolate the research data to other sites and conditions.

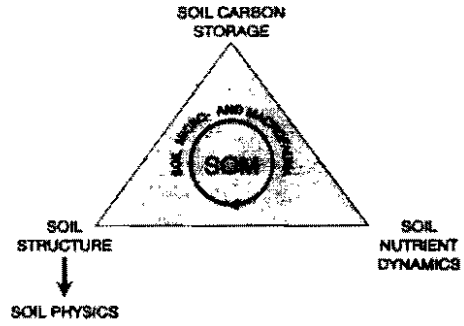


Figure 1: *Soil organic matter (SOM) forms the pivot on which hinge many other biophysicochemical soil processes.*

The overall objective of the proposed project is ***to develop, through an improved understanding of processes, methods of managing soil organic matter and organic inputs to enhance soil conservation, improve nutrient cycling and stabilize agricultural production under subsistence farming in Andean hillside agrosilvopastoral systems.***

This will be achieved by obtaining and utilizing the following outputs:

Output 1: *Increased knowledge on soil organic matter dynamics in the range of volcanic soils found in the catena.*

Output 2: *Increased understanding of the role of soil fauna in organic matter turnover in relation to nutrient cycling and soil structure development.*

Output 3: *Locally available sources of organic inputs identified (particularly for the low-income social strata whose farmers cannot afford chemical fertilizers) and systems developed for their use as soil ameliorant in cropping systems.*

Output 4: *Effect of various land management strategies on SOM dynamics analyzed, and the consequences of this for the short- and long-term productive capacity of the soil evaluated.*

An innovative aspect of the research is the fact that it focuses on integrating chemical aspects of organic matter (*i.e.* distinguishing functional SOM fractions) with physical aspects (*i.e.* its location within the soil aggregate structure), while considering soil macrofauna as biological agents in the process of SOM turnover and soil structure formation. The final outputs of this project relate to describing how various SOM pools will change due to land management decisions, and what the consequences of those changes are for soil quality. Before such characterization can be carried out, customary SOM fractionation methods must be evaluated for their efficacy and efficiency in fractionating SOM, bonded to unique minerals found in the predominantly volcanic soils of the Andes. Such an evaluation of methods represents a valuable intermediate product. It will help in evaluating the utility of vast databases of historical soil analyses and will ensure proper interpretation of future soil analyses.

The proposed research links directly to various activities described in the existing Hillsides Program projects on "Effects of Soil Degradation" and "Prototype Systems for Ecologically-Sound Intensification of Production in the Hillsides".

PARTICIPATORY RESEARCH METHODS

C I A L s

Comités de Investigación Agrícola Local

JAA-PanField.wp

THE CIAL PROGRAM :

Local Agricultural Research Committees

THE LOCAL AGRICULTURAL RESEARCH COMMITTEE (Comité de Investigación Agropecuaria Local-"CIAL" in Spanish) is a group of four farmers elected by their community to test new agricultural technologies. The committee identifies community priorities and needs for information about a topic, such as varieties, fertilizers, animal feed mixes, or soil conservation, and then decides what to test. Each committee manages a small fund to finance its experiments, which the committee plans, executes, and evaluates, to determine whether to recommend an innovation to other local farmers. Results obtained by a committee are shared regularly with its community and with others. Committees train local farmers, and may multiply seed or obtain bulk supplies of needed inputs, to ensure rapid adoption and dissemination of the benefits of new technologies.

THE CIAL PROGRAM is designed to build a sustainable, community-based capacity for innovation in agriculture, using methods that promote farmers' active participation in research. Because public-sector research institutions in developing countries cannot service the diverse needs of large numbers of low-income farmers in many different ecologies, the CIAL program mobilizes local leadership to integrate indigenous technical knowledge and modern technology. As a result, locally appropriate and environmentally sound practices, acceptable to farmers, can be identified at very low cost. Since 1990, the CIAL program has established committees in 32 rural communities, the majority in response to local demand. The committees receive training in participatory research, experimental methods, farm administration, and accounting. They work with around 6000 farm families in their pilot area in rural Colombia.

The CIAL program is a special project of the International Center for Tropical Agriculture (CIAT) in collaboration with the Carvajal Foundation and FUNCOP (Fundación para la Comunicación Popular), supported by a grant from the W.K. Kellogg Foundation.

THE ACTIVITIES OF A LOCAL AGRICULTURAL RESEARCH COMMITTEE are based on the 5 steps of participatory research in which committees are trained: diagnosis, planning, setting up the experiment, evaluating the experiment, and reporting results to the community.

Participatory diagnosis is conducted by a committee with the rural community, farmers' association or cooperative which has elected it. In the diagnostic meeting, local farmers speak about doubts or questions they have that need to be resolved. The methodology enables these ideas and suggestions to be prioritized in terms of their importance to the community, how long the experiment might take, or the existence of information on the topic, among other criteria. In this way the community defines its top priority for the committee to work on.

Participatory planning of the experiment by the committee is the next step, and it involves local farmers deemed knowledgeable experts on the chosen topic by the community. If a community chooses a topic or a crop that is completely novel, the committee seeks information with the help of local governmental agencies and NGOs, or by visits to other communities.

Setting up the Experiment. Once the necessary information has been obtained, the committee works with the CIAL program agronomists or extension agents to design a simple trial, comparing the innovation of its choice with a check treatment. Many communities begin by selecting varieties, and then go on to test fertilizers, new intercropping arrangements, or planting distances in subsequent trials.

Participatory evaluation involves the committee and local farmers in defining the criteria by which they will select the treatment they prefer: for example, the best maize variety, or the best method of weed control. The group evaluates each treatment in this way, and keeps a simple record.

Table 2. Quality of on farm trials conducted by farmers' Committees (CIAL) September 1992 - August 1993

TYPE OF CIAL	No. of plots	Percent statistically analysable	Percent unanalysable: due to drought	Percent unanalysable: due to poor institutional back-up
MATURE (PILOT)	15	100	0	0
INTERMEDIATE	30	50	20	30
NEW	24	75	12.5	12.5
TOTAL	69	70	13	17

Table 3. Comparison of manpower requirements of an on-farm managed by CIAL and by extension

Trial management	Mandays Required [1] (N)	Total cost of manpower [2] (US$)
BY EXTENSION RESEARCH	14	108
BY NEW CIAL (CYCLE 1)	13	100
BY INTERMEDIATE CIAL (CYCLE 2)	6	46
BY MATURE CIAL	4	32
INPUT PER FARMER	14	54

Notes: [1] Excludes crop management after trial establishment which is variable depending on the crop; and initial diagnosis.

[2] Farmer's time costed at minimum wage.
Extension agent costed at 2 x minimum wage.

Reporting results in a meeting of the community ensures that the committee really understands its results and can communicate these to other farmers. This is the moment when many questions, ideas, and information are exchanged; the group then decides what to do next.

Results

Over three planting seasons, some Local Agricultural Research Committees have begun to develop small businesses in multiplying and selling seed of the improved varieties they have selected, with state approval. One committee is setting up a bakery to produce bread using the soybean varieties it selected. Some committees concentrate their efforts on improving their local food supply and reducing their purchases of food; others are testing crops destined for industrial use and even for established export markets.

SETTING UP A LOCAL AGRICULTURAL RESEARCH COMMITTEE requires a small fund (in Colombia, US$500 is donated to each committee) and an extension agent, paraprofessional, or farmer who can be trained as a trainer.

Training trainers. The CIAL program has a small permanent staff of B.S.-level professionals, assisted by CIAT, which provides methodology and "training-for-trainers" to these professionals. The program staff trains government and NGO extensionists, and university students, who in turn train the Local Agricultural Research Committees.

Training a committee usually involves bimonthly visits by the trainer until results of the committee's first experiment are reported to the community. From then on, trainers visit less frequently as the committee gradually assumes more and more responsibility for planting, evaluating, harvesting, and reporting results. A vital link between the committee and extension and research agencies must be forged during this training period, so that one program staff member can be accessible on two important occasions: when a committee plans an experiment, and when results are interpreted.

Continuity. The CIAL program has found that farmers with experience in a Local Agricultural Research Committee can train new members and set up new committees. Backup is needed from a professional trainer in the meetings for planning and interpretation of results. This farmer-to-farmer training means that committee members can train their replacements, ensuring that the institution endures over time.

Learning to keep records is an important feature of this training. This enables committees to acquire a "memory"; they can then exchange their results with other communities.

HANDBOOKS on forming a committee, steps in the participatory methodology, and farm administration and accounting are available for farmers and trainers.

THE BENEFITS OF LOCAL AGRICULTURAL RESEARCH COMMITTEES MEAN THAT...

...this Committee brings a rapid flow of new agricultural technologies and information to poor farmers who cannot be reached by conventional agricultural research.

...the Committee tests new technologies under local agroclimatic conditions, using local management practices, and evaluates them according to local farmers' criteria, providing a unique, adaptive on-farm testing service.

...state research services receive rapid, timely feedback via committees on the acceptability to farmers of anything new they test. This helps research to design more appropriate technology.

...via their Committees, poor farmers can articulate their demand for new technologies, instead of simply receiving blanket recommendations. Comm .ttees act as "spokespersons" with officialdom.

...committees provide credit agencies with accurate data on production costs in their area via their training in accounting. This helps committees to obtain better terms for credit in their communities.

...local leadership in the rural community is mobilized by the Committee to participate actively in agricultural innovation. Some committees finance the cost of time devoted to experimentation by committee members through fund raising they initiate.

...farmers learn important business-management skills that help them to convert their agricultural production into small agroindustry enterprises.

...Local Agricultural Research Committees are a nucleus of action for natural resource conservation in the community. Many existing committees are introducing and promoting soil conservation and reforestation.

27 July 1992