

Output 4. Institutional capacity for SWNM enhanced through the dissemination of concepts, methods, tools and training

Activity 4.1 Organize and coordinate field days and workshops

Highlight:

- Nine Field days were held in Pescador (October 2000 – October 2001), Cauca, Colombia with the participation of 212 visitors mainly farmers, extensionists and students from universities and schools.
- Coordinated field day and workshop entitled: “Nuevos conceptos para el manejo de suelos en los Llanos Orientales de Colombia” (New concepts for soil management in the Eastern Plains of Colombia), Villavicencio, Colombia, July 10-13, 2001. This course was attended by 120 persons and was financed by MADR of Colombia.

Activity 4.2 Prepare guidelines/pamphlets on soil, water and nutrient management concepts

Highlight:

- The new pamphlet series **Agroecology Highlights** has been launched with four contributions from team members: 1) Farm nutrient recycling through double purpose live barriers, 2) Improved fallows: an alternative for rapid restoration of degraded soils, 3) Opportunities for increasing the efficiency of phosphorus use in tropical agroecosystems and 4) Harnessing the biological plows of the soil: soil macrofauna communities. The objective of this series is to provide in a compact (single two-side page) and graphic form summarized user-friendly information about important new approaches taken by PE-2 towards improved agroecosystem management and soil health.

Activity 4.3 Promote and participate in specialized training courses, prepare training materials

Highlight:

- Coordinated training course entitled: “Local Indicators of Soil Quality”, held in Arusha, Tanzania and sponsored by CIAT, SWNM, TSBF and AHI

Activity 4.4 Publish research results in refereed journals and other publications

Highlight:

- Published 28 refereed journal articles, 5 refereed book chapters, 3 edited books, 9 non-refereed book chapters and 1 article in conference proceedings.

Activity 4.5: Supervise postdoctoral research, graduate and undergraduate theses

Highlight:

- The following is a list of undergraduate and graduate students who received training with the project scientists (Table 46).

Table 46. Training supported by PE-2 and MAS/MIS consortia of SWNM Program

Name	Nationality	Education	Institution	Research theme
Axel Schmidt	German	Post-Doc	Univ.Hohenheim	Utilizing multipurpose legumes to improve soil and feed quality
Armando Torrente	Colombia	Ph.D.	U.Nacional, Palmira	Soil-water movement in Magnesian soils
Karen Tscherning	Germany	PhD	Univ.Hohenheim	Simultaneous evaluation of tropical forage legumes for feed value and soil enhancement
Brigit Krucera	Germany	Ph. D.	University of Freiburg	Characterization of bean genotypes for abiotic stress adaptation
Christian Thierfelder	Germany	Ph.D.	Univ.Hohenheim	Development of soil preserving land use systems in the tropics
Nelson Castañeda	Colombia	Ph.D.	University of Gottingen	Genotypic variation in P acquisition & utilization in <i>A. pinto</i>
Susan Buehler	Switzerland	Ph.D.	ETH, Zurich	Phosphorus acquisition/cycling
Twaha Atenyi	Uganda	Ph. D.	Agric. University of Norway	Soil phosphorus transformations and organic matter dynamics
Yolanda Rubiano	Colombia	Ph.D.	U.Nacional, Palmira	Soil degradation indicators for the Llanos
Lucero Mariani	France	Ph.D.	IRD	Impact of biogenic structures of <i>M. carimaguensis</i> (Oligochaeta, Glossoscolecidae) on soil functioning in savanna soils from Colombia
Elena Velásquez	Colombia	Ph.D.	University Nacional, Palmira	Soil quality indicators based on macroinvertebrate communities and functional parameters
Patricia Cerón	Colombia	M.Sc.	U.Nacional, Palmira	Local knowledge about soils and their management
José T. Reyes	Honduran	M.Sc.	U.Nacional, Palmira	Biological indicators of soil quality
Lina A. García	Colombia	M.Sc.	CATIE	Local indicators of water quality
Ivonne Valenzuela	Colombia	M.Sc.	U.Nacional, Palmira	Relationship between free soil water and its composition in Vertisols
Mariela Rivera Peña	Colombia	M.Sc.	U.Nacional, Palmira	Chemistry of tropical soil
Jaime Lozano	Colombia	M.Sc.	U.Nacional, Palmira	Variability of soil physical properties in CIAT Experimental Station
Fernández				
Aleyda Suárez	Colombia	B.Sc.	U. del Llano, Villavicencio	Influence of depth of compaction in maize yields
Alveiro Salamanca	Colombia	B.Sc.	U.Nacional, Palmira	Soil physical characterization under Desmodium
Carlos Alberto Cabrera	Colombia	B.Sc.	U. del Llano, Villavicencio	Characterization of degraded and non-degraded pastures in Altillanura
Carolina Becerra	Colombia	B.Sc.	U.Nacional, Palmira	Variability of soil physical properties in CIAT Experimental Station
Elio Enrique Ruiz	Colombia	B.Sc.	Univ. del Valle, Cali	Relationship between compaction and electrical conductivity
Enna Diaz Betancourt	Colombia	B.Sc.	Fundación Univ. de Popayán	Soil physical characterization in Cauca Paramo soils
Jairo Barragán	Colombia	B.Sc.	U. del Llano, Villavicencio	Influence of depth of compaction in maize yields
José Manuel Campo	Colombia	B.Sc.	U.Nacional, Palmira	Evaluation of some crop systems in relation to erosion in Volcanic Ash Soils (Pescador)

Name	Nationality	Education	Institution	Research theme
Leando Brejarano	Colombia	B.Sc.	U.Nacional, Palmira	Erodability in hillsides (Santander de Quilichao)
Liliana Paz Betancourt	Colombia	B.Sc.	Fundación Universitaria de Popayán	Soil physical characterization in Cauca Paramo soils
Lorena Parra Lopez	Colombia	B.S.	University of Valle	Screening methods for aluminum resistance in common bean
Paola Andrea Pinto	Colombia	B.Sc.	ITA, Buga	Technician, working on soil physical determinations
Robinson Parrado	Colombia	B.Sc.	U. del Llano, Villavicencio	Characterization of degraded and non-degraded pastures in Altillanura
Ximena Pernet Medina	Colombia	B.Sc.	U.del Valle-Cali/ Nacional-Palmira	Climatic studies in the Llanos
Fernando Sevilla	Colombia	B.Sc.	U.Nacional, Palmira	Soil macrofauna and farmer perception in Potrerillo watershed (Cauca)
Lina María Gaviria	Colombia	B.Sc.	University Suramericana, Neiva	Characterization of surface biogenic structures under different cassava treatments in Santander de Quilichao
Elías Claros	Colombia	B.Sc.	U.Nacional, Palmira	Agronomic evaluation sugarcane live barriers
Juliana Rizo	Colombia	B.Sc.	U.San Buenaventura	Economic analysis of sugarcane live barrier systems
Judith Cruz	Nicaragua	B.Sc.	U. Centroamericana	Ethnobotanical studies at San Dionisio reference site.
Ligia González	Nicaragua	B.Sc.	U. Centroamericana	Ethnobotanical studies at San Dionisio reference site.

Activity 4.6 Foster linkage with institutions in the region and advanced research organizations

Highlight:

- Established and maintained collaborative links with 87 institutional partners

NARS:

CORPOICA – Bucaramanga, Colombia: Hernando Méndez

CORPOICA – Espinal (Tolima), Colombia: Pedro Pablo Herrera

CORPOICA– La Libertad (Villavicencio), Colombia: A. Rincón, J.J. Rivera, C.J. Escobar, Jaime H. Bernal, Diego Aristizábal, José E. Baquero, Emilio García, Rubén Valencia, Carmen R. Salamanca

CORPOICA – Macagual, Colombia: C. Escobar

CORPOICA – Obonuco (Pasto), Colombia: Luis F. Campuzano, Bernardo García

CORPOICA – Palmira, Colombia: Jorge Peña, Gloria Ortiz

NGO's:

CARTON DE COLOMBIA, Cali: Bayron Orrego

CENICAFE, Chinchina: Senén Suárez, Horacio Rivera, Siavash Sadeghian

CENIPALMA, Bogotá: Fernando Munévar, Pedro León Gómez

COSMOAGRO, Palmira: Antonio López

CRC (Corporación Regional del Cauca), Popayán: Jesús A. Chávez

FEDEARROZ, Ibagué: Alvaro Salive, Armando Castilla

MONOMEROS COLOMBO-VENEZOLANOS, Bogotá: Ricardo Guerrero, Alberto Osorno
PALMAS DE CASANARE, Villavicencio: Hugo Londoño
CIPASLA, Pescador: Rodrigo Vivas
CORPOTUNIA: William Cifuentes
CIPAV: Enrique Murgueitio
CETEC: Kornelia Klaus, Aníbal Patiño

Regional Universities:

Universidad Nacional Agraria (UNA), Nicaragua: Matilde Somarriba
Universidad Centro Americana (UCA), Nicaragua: Alfredo Grijalva
Escuela Nacional de Agricultura (ENA), Honduras: José T. Reyes
Escuela Agrícola Panamericana Zamorano, Honduras: Margot Andrews
Universidad Central de Venezuela (UCV): Luis Bulla, Deyanira Lobo
Universidad de los Andes, Mérida, Venezuela: Lina Sarmiento, Dimas Acevedo
Universidade de Sao Paulo, Brazil: Klaus Reichardt
Universidad de Chile: M. Pinto

Specialized Institutions:

University of Gottingen, Germany: N. Claassen
University of Hohenheim, Germany: R. Schulze-Kraft, D. Leihner
University of Freiburg: Germany: E. Wellmann
Swedish Agricultural University, Sweden: Olof Andren
Agricultural University of Norway, Norway: B.R. Singh
College on Soil Physics, Trieste, Italy: Miroslav Kutilek
Universita di Trieste, Italy: Giancarlo Ghirardi
ETH, Zurich, Switzerland: E. Frossard, A. Oberson
IRD, Bondy, France: P. Lavelle, J.P. Rossi
Université de Rouen, Rouen, France: T. Decaëns
University of Ghent, Belgium: Donald M. Gabriels
Universidad de Lleida, Spain: Idelfonso Pla-Sentis
IIAG-CSIC, Galicia, Spain: María José Acea
Cornell University, USA: John Duxbury, Eric Fernandes
Michigan State University, USA: Joe Ritchie, Samira Daroub
University of California-Davis, United States: Donald Nielsen
Montana State University, USA: John Antle.
Ohio State University, USA: Rattan Lal
CIP, Ecuador: Walter Bowen
IFDC, USA: Dennis K. Friesen
FAO-Lempira Sur, Honduras: Luis A. Welchez
SERTEDESO, Honduras: Saúl San Martín
CATIE, Costa Rica: Donald Kass, John Beer
PROINPA, Bolivia: Noel Ortuño
Instituto de Ecología, La Paz, Bolivia: Ruth Sivila
Instituto de Ecología y Sistemática, Cuba: Ricardo Herrera

National Universities:

Universidad de los Llanos: E. Santana

Instituto de Educación Técnica Profesional, Roldanillo: José A. Rodríguez

Universidad de Caldas: Franco Obando, Lucrecia Quiceno

Universidad de Nariño: Hugo Ruíz, Jesús A. Castillo

Universidad del Llano: Jorge Muñoz

Universidad del Pacífico: Carlos Castilla

Universidad Nacional de Colombia: Alvaro García, Edgar Madero, Raúl Madriñan,
Eugenio Escobar, Marina Sánchez, Martín Prager

Universidad del Valle: Patricia Chacón

Universidad del Cauca: Patricia Cerón

Universidad Javeriana, Bogotá: Amanda Varela

Complementary and Special Projects

Research activities reported have been supported from a number of donors (Table 47).

Table 47. List of donors of Complementary and Special Projects

Donor/Project	Duration	Total Pledge (US\$)
ACIAR Integrated nutrient management in tropical cropping systems: Improved capabilities in modelling and recommendations.	1999-2002	434,130
BMZ-GTZ, Bonn, Germany An integrated approach for genetic improvement of aluminum resistance of crops on low-fertility acid soils.	2001–2003	690,244 (Euros)
ETHZ, Zurich, Switzerland Assessing the impact of adapted germplasm on the phosphorus fertility of low phosphorus –supplying tropical soils.	1998–2001	140,000
European Commission (EC), Brussel, Belgium Characterization of South American genotypes of bean for optimal use of light under abiotic stress.	2001-2004	831,261 (Euros)
PRONATTA, Colombia Strategies for building up productive arable layer in Altillanura soils/	2001-2004	153,000
DFID, United Kingdom Integrated Resource Management in Crop-Livestock Farming Systems of Sub-Saharan Africa.	2000-2003	602,916
SWNM Integrated Soil Management (MIS): Sustainable agricultural development. A consortium of research organizations for development.	1999-2002	370,764

Preparation of a concept note and proposal entitled 'Learning to communicate: harmonizing spatial perceptions of farmers and scientists for landscape-based agro-ecosystem management'.

Highlight:

- Concept note developed and submitted to BMZ in October 2001

Purpose:

Develop a new framework that provides for the identification of relevant information needed for specific natural resource management issues

Rationale:

The project develops a process that strengthens farmers' understanding of natural resources with formal analysis of land resources. The objective is to outline processes that allow identifying and structuring spatial information of farmers and scientists in a way that is relevant to farmers, and complements their awareness of risky land management to remove uncertainty that impedes implementation of improved land use options (Figure 38).

These processes will be investigated in watersheds in different agro-ecological hillside regions of Central America, East Africa and Southeast Asia using natural resource management (NRM) themes that may include soil and water management, diversification of agricultural systems, and impacts of tenure systems on sustainable use of forest resources. Different geographical regions and different NRM themes are considered essential to provide the bases to identify [a] general and [b] site-specific principles on harmonizing spatial perceptions of farmers and scientists.

The project explores congruencies/inconsistencies between participatory research and modeling approaches to address agro-ecosystem management issues at the landscape scale. It aims to improve interaction of scientists with the land managers by incorporating farmer perceptions in the conceptualization of problems, definition of parameters and generation of data in an iterative process of learning and action.

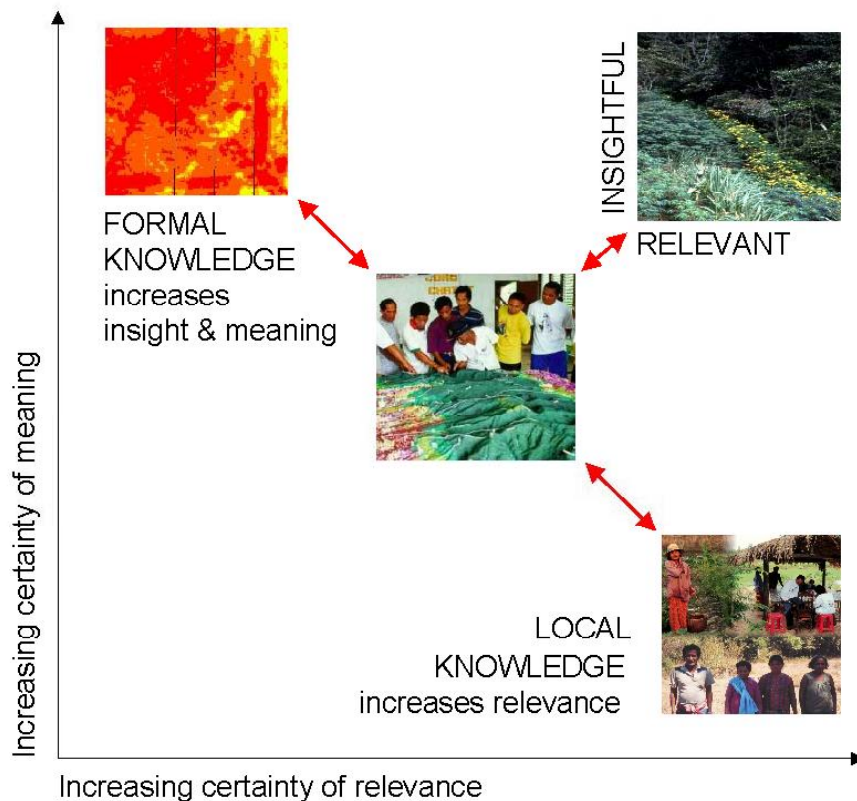


Figure 38. The integration of the local and scientific systems of knowledge: Spatial perceptions of local people are formalized and transferred into the geo-referenced and scaled spatial integrator (here a participatory 3D model) where it can be analyzed jointly with scientific outputs from models and geographical information systems. Feedback loops are hoped for and technically easily feasible. The joint analysis will produce information for NRM that is more relevant than scientific knowledge and more insightful than local knowledge on its own.

Information theory is envisioned as a framework to help identifying those principles that ultimately may lead to environmentally safe options for improved management of resource variability at the landscape scale. The project will develop this framework that filters and brings to use farmers' appreciation of land resource behavior together with conventional scientific understanding. The framework will enable us to see in which cases certain pieces of information are appropriate and can realistically be considered to generate useful information for identification and management of 'hot spots' as part of Landscape-Based Agro-Ecosystem Management (LBAM).

Contributors:

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LIST OF STAFF

Senior Staff:

Richard J. Thomas – Soil Microbiology
(Project manager until August 31)
Edmundo Barrios – Soil Ecology
(Project Manager from September 1)
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Idupulapati M. Rao – Plant Nutrition
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LIST OF PUBLICATIONS

Refereed journal articles:

1. Amézquita E., Thomas R.J., Rao I.M., Molina D.L., Hoyos P. 2001. The influence of pastures on soil physical characteristics of an Oxisol in the Eastern Plains (Llanos Orientales) of Colombia. *Agriculture, Ecosystems and Environment* (in review).
2. Barrios E., Trejo M.T. 2001. Implications of local soil knowledge for integrated soil fertility management in Latin America. *Geoderma* (in press).
3. Barrios E., Cobo J.G., Rao I.M., Thomas R.J., Amézquita E., Jiménez J.J. 2001. Fallow management for soil fertility recovery in tropical Andean agroecosystems in Colombia. *Agriculture, Ecosystems and Environment* (in review).
4. Blanchart, E., Albrecht, A., Decaëns, T., Duboisset, A., Lavelle, P., Mariani, L., Roos, E. 2001. The potential of soil macrofauna activities in reducing soil erosion: the case of endogeic earthworms. *Agriculture, Ecosystems and Environment* (in press).
5. Buehler, S., Oberson, A., Rao, I.M., Frossard, E. and Friesen, D.K. 2001. Sequential phosphorus extraction of a ³³P-labeled Oxisol under contrasting agricultural systems. *Soil Sci. Soc. Am. J.* (in press).
6. Cobo J.G., Barrios E., Kass D.L, Thomas R.J. 2001. Nitrogen mineralization and crop uptake from green manure applications to a tropical volcanic-ash soil. *Biology and Fertility of Soils* (in press).
7. Cobo J.G., Barrios E., Kass D.L, Thomas R.J. 2001. Decomposition and nutrient release by green manures in a tropical volcanic-ash soil. *Plant and Soil* (in review).
8. Decaëns T., Jiménez J.J. 2001. Earthworm communities under an agricultural intensification gradient in Colombia. *Plant and Soil* (in press).
9. Decaëns, T., Rossi, J.-P. 2001. Spatio-temporal structure of earthworm community and soil heterogeneity in a tropical pasture (Carimagua, Colombia). *Ecography*, 24 (in press).
10. Decaëns T., Galvis J.H., Amézquita E. 2001. Propriétés des structures produites par les ingénieurs écologiques à la surface du sol d'une savane colombienne. *Comptes Rendus de l'Acad. Sci. Paris, Sciences de la vie/Life Sciences* 324: 465-478.
11. Decaëns T., Mariani L., Betancourt N., Jiménez J.J. 2001. Earthworm effects on permanent soil seed banks in Colombian grasslands. *Biotropica* (in review).
12. Decaëns T., Asakawa N., Galvis J.H., Thomas R.J., Amézquita E. 2001. Surface activity of ecosystem engineers and soil structure in contrasting land use systems of Colombia. *European Journal of Soil Biology* (in press).
13. Decaëns T., Jiménez J.J., Barros E., Chauvel A., Blanchart E., Fragoso C., Lavelle P. 2001. Soil macrofaunal communities in permanent pastures derived from tropical forest or savanna. *Agriculture, Ecosystems and Environment* (in press).
14. Jiménez, J.J., Decaëns, T. The impact of soil organisms on soil functioning under neotropical pastures. A case study of a native anecic earthworm species. *Agriculture, Ecosystems and Environment* (in press)
15. Jiménez, J.J., Rossi J.P., Lavelle, P., 2001. Spatial distribution of earthworms in natural and disturbed savannas of the Eastern Plains of Colombia. *Applied Soil Ecology*, 17(3): 267-278.
16. Jiménez, J.J., Cepeda, J.A., Decaëns, T., Oberson, A., Friesen, D.K. 2001. Phosphorous fractions and dynamics in surface earthworm casts under native and improved grasslands in a Colombian savanna Oxisol. *Soil Biology and Biochemistry* (in review).
17. Lavelle P., Barros E., Blanchart E., Brown G., Desjardin T., Mariani L., Rossi J.-P. 2001. SOM management in the tropics: why feeding the soil macrofauna? *Nutrient Cycling in Agroecosystems* 62(1-2), (in press.).

18. Mariani, L., Bernier, N., Jiménez, J.J., Decaëns, T. 2001. Régime alimentaire d'un ver de terre des savanes colombiennes. Une remise en question des types écologiques. *Comptes Rendus de l'Académie des Sciences Paris, Sciences de la Vie*, 324(8): 733-742.
19. Mariani L., Decaëns T., Jiménez J.J., Torres E.A., Amézquita E. 2001. Rainfall impact on casts of various ages of the anecic earthworm *Martiodrilus carimaguensis* (Glossoscolecidae). *Geoderma* (in review).
20. Oberson, A, Friesen D. K., Rao, I. M., Buehler, S. and Frossard, E.. 2001. Phosphorus transformations in an oxisol under contrasting land-use systems: The role of the soil microbial biomass. *Plant and Soil* (in press).
21. Phiri S., Amézquita E., Rao I.M., Singh, B.R. 2001. Constructing an arable layer through vertical tillage (chisel) and agropastoral systems in tropical savanna soils of the Llanos of Colombia. *Nutrient Cycling in Agroecosystems* (in review).
22. Phiri, S., Barrios, E., Rao, I.M. and Singh, B.R. 2001. Changes in soil organic matter and phosphorus fractions under planted fallows and a crop rotation system on a Colombian volcanic-ash soil. *Plant and Soil* 231: 211-223.
23. Phiri, S., Rao I. M., Barrios, E. and B.R. Singh. 2001. Plant growth, mycorrhizal association, nutrient uptake and phosphorus dynamics in a volcanic-ash soil in Colombia as affected by the establishment of *Tithonia diversifolia*. *Journal of Sustainable Agriculture* (in review).
24. Phiri, S., Amézquita, E., Rao I.M. and Singh, B.R. 2001. Disc harrowing intensity and its impact on soil properties and plant growth of agropastoral systems in the Llanos of Colombia. *Soil and Tillage Research* 62: 131-143.
25. Ruiz, H., Legarda B. E.L., Amézquita E. 2000. Evaluación de algunos parámetros físicos bajo un suelo vertisol sometido a uso intensivo. *Revista de Ciencias Agrícolas* 27(2):107-115.
26. Wenzl, P., Chaves, A.L., Patiño, G.M., Mayer, J.E. and Rao, I. M.. 2001. Accumulation of Al-Complexing Organic Acids in Root Apices of *Brachiaria* Species under Aluminium Stress. *J. Plant Nutrition and Soil Science* (in review).
27. Wenzl, P., Patiño, G.M., Chaves, A.L., Mayer, J. E. and Rao, I.M.. 2001. The high level of aluminum resistance in signalgrass is not associated with known mechanisms of external detoxification in root apices. *Plant Physiology* 125: 1473-1484.
28. Wenzl, P., Mayer, J.E. and Rao, I.M.. 2001. Inhibition of phosphorus accumulation in root apices is associated with aluminum sensitivity in *Brachiaria*. *Journal of Plant Nutrition* (in press).

Refereed book chapters:

1. Barrios E., Schroth G. (2001) Measuring/predicting the availability of N for trees and crops. Chapter 2.2. Maintenance and replenishment of soil fertility. In IUFRO Agroforestry Working Group Manual of Research Methodologies (in press).
2. Lavelle, P., Barois, I., Blanchart, E., Brown, G. G., Brussaard, L., Decaëns, T., Fragoso, C., Jiménez, J. J., Kajondo, K. K., Martínez, M. A., Moreno, A., Pashanasi, B., Senapati, B., Villenave, C. 2001. Earthworms as a resource in tropical agroecosystems. In: Subba Rao, N. S. and Dommergues, Y. R. (eds.). *Microbial Interactions in Agriculture and Forestry*. Science Publishers, Inc., Enfield, USA; Plymouth, UK. p 163-181.
3. Miles, J.W., do Valle, C.B., Rao, I.M. and Euclides, V.P.B.. 2001. *Brachiaria* grasses. In: L. E. Sollenberger, L. Moser and B. Burson (eds) Warm-season grasses. ASA-CSSA-SSSA, Madison, WI, USA (in press).
4. Rao, I.M. 2001. Role of physiology in improving crop adaptation to abiotic stresses in the tropics: The case of common bean and tropical forages. In: M. Pessaraki (ed). *Handbook of Plant and Crop Physiology*. pp. 583-613. Marcel Dekker, Inc., New York, USA

5. Rao, I.M. and Cramer, G. 2001. Nutrition from the soil and crop improvement to utilize soil resources. In: M. Chrispeels and D. Sadava (eds). *Plants, Genes, and Agriculture*. American Society of Plant Physiologists, USA (in press).

Non-refereed book chapters:

1. Amézquita E. 2001. Las propiedades físicas y el manejo productivo de los suelos. In: A.García O., I.G. Venzuela B. (eds). *Manejo Productivo de Suelos para Cultivos de Alto Rendimiento*. Sociedad Colombiana de la Ciencia del Suelo, Comité Regional del Valle del Cauca/CORPOICA, Palmira, Colombia. pp.11-30.
2. Amézquita E., Rubiano Y. 2001. Aplicabilidad de la agricultura de precisión en el trópico. In: A. García O., I.G. Venzuela B. (eds). *Manejo Productivo de Suelos para Cultivos de Alto Rendimiento*. Sociedad Colombiana de la Ciencia del Suelo, Comité Regional del Valle del Cauca/CORPOICA, Palmira, Colombia. pp.77-93.
3. Decaëns, T., Jiménez, J.J., Rangel, A.F., Cepeda, A., Lavelle, P., 2001. La macrofauna del suelo en la sabana bien drenada de los Llanos Orientales. In: G. Rippstein, G. Escobar, F. Motta, (eds) *Agroecología y Biodiversidad de las Sabanas en los Llanos Orientales de Colombia*, CIAT / CIRAD, Cali, Colombia. p. 109-135.
4. Gómez-Carabalí, A., Rao, I. M., Beck, R.F. and. Ortiz, M. 2001. Rooting ability and nutrient uptake by tropical forage species that are adapted to degraded andisols of hillsides agroecosystem. In: N. Gaborcik (ed.) *Grassland Ecology V*, Slovakia (in press).
5. Jiménez, J.J., Decaëns, T., Thomas, R.J., Lavelle, P. 2001. Soil macrofauna: an available but little known natural resource. In: J.J. Jiménez and R.J. Thomas (eds). *Nature's Plow: Soil microinvertebrate Communities in the Neotropical Savannas of Colombia*. CIAT, Cali, Colombia. p. 1-16.
6. Jiménez, J.J., Decaëns, T., Thomas, R.J., Mariani, L., Lavelle, P. 2001. General conclusions highlights and future needs. In: J.J. Jiménez and R.J. Thomas (eds). *Nature's Plow: Soil microinvertebrate Communities in the Neotropical Savannas of Colombia*. CIAT, Cali, Colombia. p. 361-386.
7. Rao, I.M., Ayarza, M.A., Herrera, P. and Ricaurte, J. 2001. El papel de las raíces de especies forrajeras en la adquisición, reciclaje y almacenamiento de nutrientes en el suelo. *Memorias de Curso Internacional "Investigación y Desarrollo de Sistemas de Producción Forrajera en el Tropicó"*. CIAT, Cali, Colombia (in press).
8. Rao, I.M, Rippstein, G. Escobar, G.G and. Ricaurte, J. 2001. Producción de biomasa vegetal epígea e hipógea en las sabanas nativas. In: G. Rippstein, G. Escobar and F. Motta (eds.) *Agroecología y Biodiversidad de las Sabanas en los Llanos Orientales de Colombia*. CIAT, Cali, Colombia. pp.198-222.
9. Rippstein, G., Amézquita E., Escobar G., Grollier C. 2001. Condiciones naturales de la sabana. In: Rippstein G., Escobar G. and Motta F. (eds.) *Agroecología y Biodiversidad de las Sabanas en los Llanos Orientales de Colombia*. CIAT, Cali, Colombia. pp.1-21.

Edited books

1. Barrios E., Bekunda M., Delve R., Esilaba A., Mowo J. 2001. Identifying and classifying Local Indicators of Soil Quality – East African Edition. *Participatory Methods for Decision Making in Natural Resource Management*. CIAT, SWNM, TSBF, AHI. 154 p.
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2. Rao, I. M. 2001. Adapting tropical forages to low-fertility soils. Proceedings of XIX International Grassland Congress, pp. 247-254. Brazilian Society of Animal Husbandry, Piracicaba, Brazil.
3. Rao, I. M. 2001. Limitaciones edáficas climáticas para la producción de frijol común. Proceedings of the conference on “Manejo productivo de suelos para cultivos de alto rendimiento. Palmira, September 27-28.

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1. Rao, I.M., Plazas, C. and Ricaurte, J. 2001. Root turnover and nutrient cycling in native and introduced pastures in tropical savannas. pp. 976-977. In: W. J. Horst, M. K. Schenk, A. Burkert, N. Claassen, H. Flessa, W. B. Frommer, H. Goldbach, H. –W. Olf, V. Romheld, B. Sattelmacher, U. Schmidhalter, S. Schubert, N. v. Wiren and L. Wittenmayer (eds.) Plant Nutrition: Food security and sustainability of agro-ecosystems through basic and applied research. Kluwer Academic Publishers, Dordrecht, The Netherlands.

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1. Amézquita, E. 2001. Conference presented at the VII Seminario de Pastos y Forrajes “Manejo y Utilización de Pastos y Forrajes en Sistemas de Producción Animal”. Guanare (Barinas), Venezuela, March 14-17.
2. Amézquita, E. 2001. El concepto de la capa arable. Conference presented at the Curso “Nuevos conceptos para el manejo de suelos en los Llanos Orientales de Colombia”. Villavicencio, Colombia. July 10-13.
3. Amézquita, E. 2001. Impacto de los sistemas de labranza en las características de suelos volcánicos, and Condiciones de suelo para lo no labranza. Conferences presented at the Seminario-Taller “Labranza de Conservación en Suelos de Ladera”, CORPOICA C.I.-Obonuco, June 21-22. Pasto, Colombia.
4. Amézquita, E. 2001. Soil physical characteristics and land degradation in savanna Oxisols of Colombia. Poster presented at 3rd International Conference of Land Degradation ICLD and Meeting of the IUSS Subcommission C Soil and Water Conservation. Rio de Janeiro, Brazil, September 14-22.
5. Araya, R. and I. Rao. 2001. Evaluación de fuentes de resistencia baja fertilidad en frijol común. Paper presented at XLVII Annual Meeting of PCCMCA, San Jose, Costa Rica.
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7. Barrios E., Delve R.J., Thomas R.J. 2001. Integration of local soil knowledge for improved soil management strategies. Workshop on Integrated Management for Sustainable Agriculture, Forestry, and Fisheries, CIAT, Palmira, Colombia, August 28-31.
8. Beebe, S., Téran, H. and Rao, I.M. 2001. Progreso en el desarrollo de líneas de frijol resistentes a sequía con grano rojo y negro en CIAT, Cali, Colombia. Paper presented at XLVII Annual Meeting of PCCMCA, San Jose, Costa Rica.
9. Chávez, L.F. 2001. La construcción de una capa arable: Práctica clave para una agricultura sostenible en suelos de la Altillanura Colombiana. Presented at the College on Soil Physics, International Center for Theoretical Physical, Trieste, Italy. March 12-April 2.

10. Chávez, L.F. 2001. Experiencia en siembra directa en los Cerrados del Brasil. Conference presented at the Curso “Nuevos conceptos para el manejo de suelos en los Llanos Orientales de Colombia”. Villavicencio, Colombia. July 10-13.
11. Jiménez, J.J. 2001. Caracterización de la biodiversidad del suelo y el desarrollo de estrategias para favorecer los procesos biológicos en el suelo. Taller de Planificación de Actividades. Consorcio Manejo Integrado de Suelos Frágiles en Centro América (MIS), Playa Negra, Amapala, Honduras, 14 –17 February.
12. Jiménez, J.J. 2001. La Biodiversidad en el suelo y papel funcional de la macrofauna. Ejemplos de la sabana colombiana. Taller sobre Manejo de Indicadores Biológicos del Suelo. CORPOICA, Tibaitatá, Bogotá, Colombia, 21-22 June, 2001.
13. Oberthur T., Barrios E., Cook S., Thomas R. 2001. Variation of Soil Characteristics in a Sub-Watershed of the Mid-Altitude Andes: Magnitude and implications for Landscape-Based Soil Management. Workshop on Integrated Management for Sustainable Agriculture, Forestry, and Fisheries, CIAT, Palmira, Colombia, August 28-31.
14. Rao, I.M., Beebe, S., Ricaurte, J., Téran, H. and Singh, S.P. 2001. Frijol común (*Phaseolus vulgaris* L.) con mejor adaptación a toxicidad de aluminio. Paper presented at XLVII Annual Meeting of PCCMCA, San Jose, Costa Rica.
15. Rivera, M. 2001. Perfiles de conductividad hidráulica no-saturada en algunos sistemas de uso de suelo: Arroz monocultivo, Arroz en rotación con caupí y savanna nativa en los Llanos Orientales de Colombia. Presented at the College on Soil Physics, International Center for Theoretical Physical, Trieste, Italy. March 12-April 2.
16. Rubiano, Y. 2001. Distribución de los suelos en los diferentes paisajes de la Orinoquía. Conference presented at the Curso “Nuevos conceptos para el manejo de suelos en los Llanos Orientales de Colombia. Villavicencio, Colombia. July 10-13.

Other documents:

1. García, C., Franco, M.A., Quintero, J. and Rao I.M. 2001. Catálogo de Cepas de Micorrizas Arbusculares. CIAT, Cali, Colombia, pp. 78.

List of Acronyms

ACIAR	Australian Centre for International Agricultural Research, Australia
AUN	Agricultural University of Norway, Norway.
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza (para América Central), Costa Rica.
CENICAFE	Centro Nacional de Investigaciones en Café, Chinchiná, Colombia
CENIPALMA	Centro de Investigación en Palma de Aceite, Colombia
CIAT	Centro Internacional de Agricultura Tropical, Colombia
CIDIAT	Centro Internacional de Desarrollo Integral de Aguas y Tierras, Venezuela.
CIELAT	Centro de Investigaciones Ecológicas de los Andes Tropicales, Venezuela.
CIPASLA	Consortio Interinstitucional para la Agricultura Sostenible en Laderas, Colombia.
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement, France
CNPAB	Centro Nacional de Pesquisa de Agrobiologia, Brazil
COLCIENCIAS	Instituto Colombiano para el Desarrollo de la Ciencia y la Tecnología “Francisco José de Caldas”, Colombia
CORPOICA	Corporación Colombiana de Investigación Agropecuaria, Colombia.
CPAC	Centro de Pesquisa Agropecuaria dos Cerrados (of EMBRAPA)
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
DFID	Department for International Development
EC	European Comisión, Belgium
ENA	Escuela Nacional de Agricultura
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuaria, Brazil
ETH	Institut for Plant Science, Zurich
FAO	Food and Agriculture Organization of the United Nations, Italy
FEDEARROZ	Federación Nacional de Arroceros, Colombia
GTZ	Technical Cooperation, Germany
IAEA	International Atomic Energy Agency, Vienna, Austria
IBSRAM	International Board for Soil Research and Management
ICRAF	International Centre for Research in Agroforestry, Nairobi, Kenya
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
IFDC	International Fertilizer Development, USA
IRD	Institut Français de Recherche scientifique pour le Développement et Coopération, France.
IRRI	International Research Institute
LAC	Latin American and the Caribbean
MAS	Management of Acid Soils (of SWNM of the CGIAR), CIAT Colombia.
MIS	Integrated Soil Management (of SWNM of the CGIAR), CIAT Honduras
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organization
PRONATTA	Programa Nacional de Transferencia de Tecnología, Colombia
SLU	Swedish Agricultural University
SOL	Supermercado de Opciones para Laderas
SWNM	Soil, Water and Nutrient Management (systemwide program of the CGIAR), CIAT Colombia.
TSBF	Tropical Soil Biology and Fertility Program, Nairobi, Kenya
UNA	Universidad Nacional Agraria, Nicaragua