PROJECT PE-4
SUMMARY
ANNUAL REPORT 2002

Land Use in Latin America

October 2002

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PE-4 PROJECT

Project Overview

Project Description

Objective: By providing relevant information about land use change, the project aims to help decision makers, ranging from farmers to World Bank investors, reduce the uncertainties of development.

Outputs:
1. Baseline and time-series data for subsequent analysis performed.
2. Information and insight of biological limitations and drivers of land use change developed.
3. Analysis and prediction of socioeconomic factors influencing land use development performed.
4. Analysis and prediction of vulnerability of land use systems to significant external events performed.
5. Methods of capturing farmers' knowledge in land use division support developed.

Gains: Detailed georeferenced databases on land use, ecological, and socioeconomic factors. Environmental and sustainability indicators of land use, networking on the environment, land use, sustainable agriculture, and indicators. A blend of theoretical, methodological, and field-based inquiry for decisions on sustainable agriculture. Upscaling and extrapolation tools available for a variety of uses.

Milestones:

2002 Germplasm targeting tool completed (Beta version). World climate surfaces upgraded to 1-km grid. *FloraMap 2.0* released. *Dynamic Land Use Model* (Beta version) released. Indicators for sustainability at the municipality level published for Andean countries.

2003 Strategic databases on agricultural, environmental, social, and economic issues maintained and updated. Environmental and sustainability indicators routinely distributed to decision makers in the region at different levels. Remote-sensing information on land use changes in tropical America routinely collected and available for different purposes. Integrated GIS and mathematical models to support land management decisions by national organizations. National and local institutions from tropical America strengthened to use information, analysis, and tools.

2004 Data, analyses, and tools for natural resource management disseminated throughout tropical America and other tropical areas of the world.

2005 Delivery of second-order information products (e.g., policy guidelines, analytical methods, or information exchange networks) that will reduce the risks associated with specific land use changes that might otherwise threaten the well-being of significant numbers of rural people in the tropics. These will address specific issues such as water productivity, climate change, and application of new germplasm.

Collaborators: ICRAF, CIP, ILRI, ECLAC, Univ. Guelph (Canada), IICA (Costa Rica), IILA (Italy), IIASA (Austria), WRI (USA), RIVM (Netherlands), TCA (Amazonian Cooperation Treaty), Earth Council (Costa Rica), World Bank; NARS, GOs, and NGOs in Latin America: DNP, IGAC, MinAmbiente, IDEAM, CARDER (Colombia); Ministry of the Environment, EMBRAPA (Brazil); IVITA, INIAA (Peru); INIAP (Ecuador).

CGIAR system linkages: Protecting the Environment (60%); Improving Policies (20%); Enhancement and Breeding (10%); Saving Biodiversity (10%). Contributes to the Ecoregional Program for Tropical Latin America.

CIAT project linkages: GIS studies assist SB-1, SB-2, IP-1, and PE-2; model development with PE-3, PE-5, and BP-1.

Project Logframe - Workplan 2002-2005

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal To reduce the risk of agricultural development in the tropics by providing spatial information about significant opportunities and threats of natural resource management.	Risk recognized as a reducible factor. Information adopted by decision makers. CIAT, CGIAR, or other collaborating research institutional activities enhanced by the ability to target activities.	Policy, projects, or funding strategies modified identifiably to include spatial information. Research portfolios modified identifiably by targeting or pre-selection. Risk management strategies, based on spatial information, included in development projects.	
Purpose To enable decision makers, ranging from farmers to World Bank investors, to reduce the uncertainties of development by providing relevant information about land use change.	Decision makers use spatial information to reduce risk.	Documented case studies at farm, national, and regional scales. Published methods of generalizing improved decision making, using spatial information of land use.	That uncertainty significantly obstructs land use decisions at a range of scales. That spatial variation introduces significant uncertainty to these problems. That relevant spatial information can be generated in a cost-effective manner.
Output 1 Baseline and time-series data for subsequent analysis performed.	Population, crop, and selected databases generated. Rainfall model available to collaborators in the tropics. Detailed climate data sets developed for modelers. Detailed future climatic data sets used to predict climate change effects.	Information available at CIAT. Selected information downloadable at CIAT Web site.	Information can be delivered to analysts and decision makers.
Output 2 Information and insight of biological limitations and drivers of land use change developed.	Threats of global climate change (GCC) to regional crop production defined for entire regions. Threats of climate change to plant genetic resources defined. Models developed for defining the impact of GCC on the potential productivity of a range of crops developed.	Maps and databases completed. Models developed, calibrated, verified, and published. Projects developed to apply models.	Sufficient data are available to generate insights.

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Output 3 Analyses and predictions of socioeconomic factors influencing land use development performed.	Spatial processes driving land use change identified. Impacts of policy, external forces, or physical geography improved. Distribution of poverty and its causes identified more accurately, using spatial information.	Published explanations of the improved accuracy of explaining land use change. Spatial drivers of poverty explained in published case studies by June 2004. Information used to direct poverty alleviation policy. Information used to target further research activity.	Sufficient data are available to generate insights. Links exist with governmental and NGO partners to enable implementation of poverty alleviation policies.
Output 4 Analyses and predictions of vulnerability of land use systems to significant external events performed.	Indicators of vulnerability adopted by policy agencies. Spatial information on vulnerability used to reduce investment risks in at least one country case study.	Methods of vulnerability assessment published with case study at national or regional scale by June 2004. Ex ante analysis of the benefits of risk reduction published.	Sufficient data are available to generate insights.
Output 5 Methods of capturing farmers' knowledge in land use decision support developed.	Strengths and weaknesses, overlaps and gaps identified between farmer and scientist knowledge with respect to locally (e.g., declining soil fertility) and globally rooted resource-base management problems (e.g., climate change). Respective roles of farmers and scientists identified in local decision problems about locally and globally rooted resource-base problems. Farmer-to-farmer decision-support network established that tackle selected locally and globally rooted resource-base problems.	Case study documented of farmers generating information and merging with "hard" data on natural land resources. Network of farmer support initiated, including a minimum of 200 users at second-order organization level. Generated methods and tools documented and disseminated.	Sufficient data are available to generate insights. Local structures enable network establishment.

Investigators:

Simon E Cook	PhD, Crop Biology	Project Manager
Glenn G Hyman (30%)	PhD, Geography	Senior Staff (Outposted)
Grégoire Leclerc* (30%)	PhD, Physics	Senior Staff (Outposted)
Manuel Winograd	PhD, Ecology	Senior Staff (Outposted)
Thomas Oberthür	PhD, Geography	Senior Research Fellow
Steffen Schillinger*	MSc, Geology	Senior Research Fellow
Douglas White✍	PhD, Economics	Senior Research Fellow
Arjan Gisman✍	PhD, Agronomy	Senior Associate
Nathalie Beaulieu*(50%)	PhD, Remote Sensing	Research Fellow (Outposted)
Andrew Farrow	MSc, GIS	Research Fellow
Andrew Jarvis (50%)	MPhil., Geography	Research Fellow
Peter G. Jones	PhD, Crop Physiology	Consultant
Jorge Rubiano✍	PhD, Geography	Consultant
Jaime Jaramillo	MSc, Civil Engineering	Research Specialist
Juan Gabriel León*	*Ingeniería Agrícola*	Postgraduate Student
Rachel O'Brien	MSc, Computer Science	Postgraduate Student
Yolanda Rubiano	BSc, Remote Sensing	Postgraduate Student

* Left during 2002
✍ Arrived during 2002

Cooperators:

Within CIAT: See under CIAT project linkages of the Project Description on page 1.

Outside CIAT: See under Collaborators and CGIAR Systems Linkages of the Project Description on page 1.

Financial Resources:

Source	Amount (US$)	Proportion (%)
Unrestricted core	899,641	56
Restricted core	99,324	6
Carryover from 2001	115,811	7
Subtotal	1,114,776	70
Special projects	488,111	30
Total Project	**1,602,887**	**100**

Research Highlights in 2002

1. MarkSim and FloraMap

MarkSim: Tackling the data divide with high-resolution synthetic weather data
The lack of reliable weather data, and the profound uncertainties that this creates, remains a major impediment to agricultural development in the tropics. It affects farmers, and policymakers and researchers who aim to support them. In the developed world, literally billons of dollars are invested to acquire information about the weather, but it is unrealistic to expect even a fraction of this investment for tropical regions, so cost-effective methods are required to generate estimates that *look* like this expensive daily weather data, but at a fraction of their cost. MarkSim™ represents the culmination of over 25 years of world-class research to solve this problem, by simulating high-resolution, daily weather data for the entire pan-tropical region. It does this on the basis of the statistical characterization (Markov simulation) of data from 11,000 weather stations worldwide, and estimating similar values for each 18-km grid cell. The MarkSim method has been rigorously tested, and has now been released as a Windows® commercial version on CD-ROM with a 96-page users' manual.

MarkSim has been applied to the output from Global Circulation Models (GCMs) to create daily weather data for 25 and 50 years from now. These were used as input to the DSSAT crop simulation model and thereby predict the likely impacts of climate change on maize production in Latin America and Africa. The results show complex effects of climate change. In a few areas, yields appear to increase. In many areas, a mild yield decrease could be handled by varietal change and breeding for increased stress. In others, the prospects for continued agriculture are poor, and major changes in the agricultural system seem evident. Overall, the yield decrease could be 10%, or $2 000 000 000's worth of maize crop.

FloraMap version 1.01 is now released and available. FloraMap, MarkSim's stable mate, has completed its first print run of 500 in just over 1 year, and is being used by an estimated 200 active researchers. The manual has been fully revised, a new section added in the theory chapter describing the new data rotation incorporated (now downloadable form the CIAT Web site), and new climate grids included. A further 200 CD-ROM copies were burned of this new version of FloraMap, which, along with a reprint of the updated manual, will satisfy demand until the major release of FloraMap 2.0 that we hope to achieve in 2003.

2. Mapping food security and poverty through the Consortium for Spatial Information

Poverty alleviation is central to the mission of the CGIAR and other development organizations. Yet knowledge about where poverty and food insecurity exists, and what are their modifiable drivers, is still deficient. This is partially because of a historic dearth of appropriate information. But, as the volume of data increased, it related more to our inability to access it, analyze it, and communicate the results to people who need them. Out of this was created the Consortium for Spatial Information (CSI, http://www.spatial-info.org), a network of nine CG Centers (subsequently expanded to 12 Centers), and, from the CSI, the joint CSI-Food and Agriculture Organization (FAO)-United Nations Environment Programme (UNEP) poverty mapping project. This year saw the confluence of parallel developments in three fields: GIS software, building of data-sharing capacity, and spatial analytical

methodology that has enabled a significant step towards the goal of a global capacity to map poverty and its causes at national scale. These development were: (a) introduction of ArcIMS software, which provides real-time, dynamic Web-based mapping so that data from multiple sources can be analyzed over the Internet; (b) Geospatial Applications to Support Sustainable International Agriculture (GASSIA) technical training workshop (with USGS, see http://edcintl.cr.usgs.gov.gassia.html) on intellectual property rights (IPR) and spatial data infrastructure requirements to enable Centers to interact with clearinghouses; and (c) Training in spatial analytical methods, and application to national scale poverty mapping in nine country case studies, funded through the CSI-FAO-UNEP.

3 Local knowledge with global impact

The power of farmers' knowledge to describe the natural resources they manage has been known for some time. This power is increased substantially if it is linked with a more generalizable scientific understanding. However, normal language seems too impoverished to capture the richness of both sources of information, so methods of participatory three-dimensional mapping have been refined and advanced that use representations of the landscape itself as a common language. A method was developed with farming communities in Cauca (Pescador) and Valle del Cauca (Yotoco and Restrepo) that allows farm-scale to catchment-scale joint analysis of local and scientific perceptions of genetic and biophysical systems using georeferenced participatory three-dimensional models, which can be transferred to GIS for continued analysis. The method has been presented at several workshops and a manual is currently under preparation (see http://gisweb.ciat.cgiar.org/sig/local-knowledge.htm). A clear relation has been revealed between a local land quality classification at catchment scale and the biodiversity of the soil macro-fauna. It has been shown that various land uses lead to different soil chemical and physical conditions that have distinct impacts on soil biodiversity at the catchment scale. This provides a basis for practical, diagnostic soil quality indicators.

A practical problem with farmer participatory methods is acquiring hard data at the resolution that farmers like. A method is being developed to acquire rapid, accurate, high-resolution photography at low cost, using kites and balloons. This information is georeferenced so that it can be merged with other information (including that from participatory three-dimensional mapping) in GIS, and enable spatial and temporal monitoring of genetic and biophysical resources. This is an invaluable tool for on-farm crop experimentation.

4 Land use planning in Puerto Lopez: Putting GIS to work on the ground

As part of the Convenio Colombia, this work has developed a framework and mapping tools to lead towards the development of long-term (POT) and shorter-term (PDM) land use plans. While remaining strongly participatory, this framework entrains a number of technical contributions, including a multiple-scale vision-actions-request framework, multi-temporal classified satellite imagery, GEOSOIL, "Arboles de Decision" and *ex ante* assessment of agricultural products. With CIAT's support, the municipality of Puerto López developed a concerted plan that will guide its activity and expenditures over the next 3 years. The "PLAN DE DESARROLLO 2001-2004, "*Por la Reconciliación y Unidad de Puerto López"* will be an instrument to apply the "*Plan Básico de Ordenamiento Territorial*" of Puerto López. The plan, ratified earlier this year, will officially be launched o CD-ROM at the end of the year.

Problems encountered and their solutions:

This project, in common with many others, needs to focus its activities on fewer achievable targets that contribute significantly towards the long-term aim of poverty alleviation. These targets are often elusive, and adopting reasonably stable goals around which scientists, projects (and institutions) can organize in teams enhances our probability of success. This process was disrupted in previous years, and has only been established this year with special effort on teamwork, agreement on strategic directions, and a common focus to develop a research portfolio that balances strategic science with practical deliverable outcomes. This process is not helped by disorganization, lack of clarity, or constantly shifting objectives within the organization as a whole.

Funding is a perennial concern, and this year the project suffered from inadequate special project funding as a consequences of too few proposals being developed 2 years previously. Special effort has been required this year to seek external funding, but the process takes time. More proposals will be required next year before the project can expect a stable portfolio of special projects. Partially related to this problem, we perceive that, since Latin America receives low priority with some donors, we need to expand activities beyond this regions to areas where we can make a contribution based on experience here, in particular SE Asia, and more possibly Africa.

Proposed plans for next year:

Plans for 2003 are partially dependent on how CIAT reorganizes. This will have significant impact upon us, yet to date the practical implications are not clear. Some activities we expect include:

?? We will develop work for the Water Challenge Program, particularly looking for projects based in the Andes, the Mekong, and possibly the Ulua catchments. We will be looking to develop work with EMBRAPA at the São Francisco Basin, which is a nominated CP benchmark basin.
?? On the assumption that Climate Change will be a significant part of CIAT's efforts, we will look for applications of climate change research – how to apply to problems of risk, land use, and protection of biodiversity. The next phase is to look for strong applications.
?? We plan to take the vulnerability indicators and develop these into more concrete deliverables – not just policy, but also tools, such as insurance. We are already making contacts for this work.
?? The local knowledge work needs to be taken and applied to concrete examples, such as fruit, organic coffee production, or other novel products, and developed with the Institute for Rural Innovations. The emphasis is on having specified applications.
?? The work for Convenio Colombia will pass to the Institute for Rural Innovations, and we will look to respond to their demands for specialist information products.
?? The poverty mapping work needs to progress from the mapping of the distribution of poverty to identifying modifiable drivers of poverty.

Project Performance Indicators: Land Use in Latin America 2002

1. TECHNOLOGIES, METHODS, AND TOOLS

1.1. Methodologies

- Developing stochastic simulation of rainfall events using improved Markov models
- Developing climatic indices for climate applications using Morton key routines and appropriate search algorithms
- Developing data and technical infrastructure for spatial online data analyses, spatial data search, and mapping
- Developing similarity analyses using fuzzy-k clustering techniques
- Developing and applying routines for remotely sensed image classification and interpretation
- Developing and applying ecological correlation analyses using multivariate and probability statistics, and spatial and temporal analyses techniques
- Applying deterministic and probabilistic models for natural disaster modeling
- Developing different spatial cost and economic analyses techniques, using for example accessibility analyses and linear programming analyses
- Developing GIS-based models for spatial modeling of soil resources
- Developing algorithms for poverty mapping incorporating amongst other techniques, accessibility analyses, and spatial autocorrelation algorithms
- Identifying spatial prediction algorithms for biological mapping
- Developing approaches to predict global climate change impacts on agriculture by combining Global Circulation Models, process models, and climate simulation
- Developing methodologies for generating low-altitude, high spatial resolution, aerial imagery
- Developing spatial sampling approaches for soil fauna studies at landscape scale
- Improving spatial socioeconomic data analysis methods

1.2. Rural Development Methods

- Advancing participatory three-dimensional modeling for community assessment and management of natural and genetic resources
- Developing low-cost aerial imaging and visualization for community assessment and management of genetic and natural resources
- Adapting the "visions-actions-requests across administrative levels" for community use
- Rule-based image processing methods to facilitate the use of remote sensing images in local planning and adaptive management
- Advancing a framework for merging scientific and local knowledge for community management of genetic and natural resources

1.3. Decision Guides/Support Tools (models/software)

- MarkSim v1.0
- FloraMap second edition
- New version of Condor 1.2, and user interface
- SINMAP (Stability Index Mapping) calibrated for San Dionisio
- Improved "Visions-actions-requests across administrative levels" method
- Beta version of GIS integrated QUEFTS (Quantitative Evaluation of Fertility of Tropical Soils) model

- GEOSOIL and "Arboles de decision": Decision support on land use and management practices
- Geographic information system CIAT experiment station
- Spatial interaction models for economic cost analyses

1.4. Databases or Maps

- "MapoTeca" (map library) of a large collection of maps
- Climatic database with new structure
- San Dionisio spatial database, including all Mitch-induced landslide occurrences
- Condor 1.2 and other databases of environmental and socioeconomic data
- Databases of *ex situ* and *in situ* collection of genetic resource information

2. Publications

2.1. Refereed Journals

Published	6
In Press	3
Submitted	4

2.2. Books 2

2.3. Book Chapters 2

2.4. CD-ROM with manual 2

2.5. Published Proceedings

Published	3

2.6. Scientific Meeting Presentations

Presentations 11

Jones, P.G.; Beebe, S. 2001. Predicting the impact of climate change on the distribution of plant genetic resources in wild common bean (*Phaseolus vulgaris* L.) in Central America. This paper was presented at the III International Conference on Geospatial Information in Agriculture and Forestry in November 2001 at Denver, Colorado. It won the award as best paper of the conference.

2.7. Working Papers, Technical Reports, or other Publications

22

(See attached Appendix I for full list by categories)

3. STRENGTHENING NARS

3.1. Training Courses

- Training and capacity building on the Rural Sustainability Indicators for Central America.
- Training on "creating local capacity for *Ordenamiento Territorial*" in Ecuador, the use of the participatory planning methodology and MapMaker software – four 1-week training courses

- Training and capacity building on the Rural Sustainability Indicators for Central America

3.2. Individualized Training

- CIAT and the United States Geological Survey (USGS) organized and carried out the Geospatial Applications for Sustainable International Agriculture (GASSIA) workshop in Sioux Falls, South Dakota from 19th to 31st of May 2002.
- On behalf of all CGIAR centers, CIAT negotiated an expanded new software and training agreement with ESRI. The agreement will give CGIAR centers greater access to GIS software and training at lower costs.
- A training program in remote sensing has begun this year in benefit of CIAT support staff and Colombian partners.
- Training courses on the use of satellite imagery were given in July 2002 to CIAT Land Use Project staff, with participants from CORPOICA and the *Universidad del Valle*. Another course was given in October in Villavicencio, Colombia, to end users in CORPOICA, the *Gobernacion del Meta*, and personnel from UMATAs of the area and of municipalities.
- Luis Fernando Morales, USDA- Animal and Plant Health Inspection Service (APHIS), Training in FloraMap and use of GIS in mapping species distribution, Feb 2002.
- Marizza Quintana, Botanist, Natural History Museum, San Lorenzo, Paraguay, training in FloraMap, April 2002.
- Universidad del Cauca - 12 students, training in DIVA and FloraMap, November 2001.
- Christoph Nowicki, Fundacion Amigos de la Naturaleza (FAN), Santa Cruz, Bolivia, training in GIS and means of prioritizing conservation, May 2002.
- GPS and GIS training Luis C Pardo Locarno (Instituto de Investigaciones Ambientales del Pacífico-IIAP), October - December 2002.

3.3. PhD, MSc and pregraduate thesis students

- PhD 4
- Pregrad 6

3.4. Workshops and Meetings

- 29th International Symposium on Remote Sensing of Environment, 8-12 April 2002, Buenos Aires, AR
- Lecture on "Management of soil variability for organic agriculture", Univalle, 27 de abril 2002, en el Curso de Agricultura Orgánica, Departamento de Física, Fac. Ciencias
- VIIIth International Plant Virus Epidemiology Symposium in May 2002, Ascherleben, Germany
- Geospatial Applications to Support Sustainable International Agriculture (GASSIA) Meeting, 19-31 May 2002, EROS Data Center, Sioux Falls, SD, USA
- 98th Annual Meeting of the Association of American Geographers, 19-23 March 2002, Los Angeles, CA workshop held 19-30 May 2002 in Sioux Falls, SD
- Primeiras Jornadas Amazônicas: Monitoreamento de transformaçoes ambientais na Amazônia. Brasilia, Junhio 5-9, 2002
- Taller sobre el Proyecto de Mejoramiento de Métodos de Análisis Espacial de la Pobreza y Seguridad Alimentaria en el Ecuador, 19-20 de Junio 2002, Hotel República, Quito

- Nuevos Conceptos para el Manejo de Suelos en los Llanos Orientales Colombianos, 8-9 July, Yopal, Casanare and 10-12 July, Villavicencio, Meta. Convenio Colombia, CIAT-Corporación Colombiana de Investigación Agropecuaria (CORPOICA)
- "La Etnobiología enfoques y perspectivas: Un reto para las ciencias duras". Seminario Internacional de Etnomedicina, organizado por la Universidad del Bosque en Santafé de Bogotá. Del 29 de Julio al 1 de agosto
- Simposio Nacional de Estadística : Estadística Aplicada a las Ciencias Ambientales. Agosto 14 al 18 de 2002, Bogotá-Colombia
- Integrated Natural Resources Management Workshop, 28-31 Aug 2001, Cali, CO
- Curso Sobre Manejo Integrado de Plagas y Enfermedades, Sept 9, Centro Internacional de Agricultura Tropical (CIAT) - Escuela Politécnica del Ejército (ESPE), EC
- Outils de la spatialisation des données environnementales. Séminaire de l'Unité Espace, Institut de Recherche pour le développement. Meze, France, 9-13 septembre 2002
- Fourth Integrated Natural Resouces Management task force workshop: Putting practice into action. Aleppo, Syria, September 16th to 19th
- III International Conference on Geospatial Information in Agriculture and Forestry, Nov 2001, Denver, CO, USA
- V Congreso Internacional y VII Nacional de Topografía, Universidad del Valle, Nov 7-10
- VIII Congreso Latinoamericano de Botánica y II Congreso Colombiano de Botánica, Cartagena, Colombia
- Presentations on and introductions to Participatory 3-D Mapping in Nicaragua (CARE Nicaragua) and Colombia (3 communities)

3.5. Technical Assistance

- Plan de desarrollo 2001-2004, "Por la reconciliación y unidad de Puerto López"
- Sensibilization and appropriation of the MP-3D methodology in two farming communities. The group from La Colonia, Yotoco, has utilized the *maqueta* to negotiate with the Corporación Regional Autónoma del Valle del Cauca -C.V.C.- a project with the Fondo Vallecaucano para la Acción Ambiental and have undertaken to give training in MP-3D and make the *maqueta* with a group of farmers of the Río Calima watershed.

3.6. ARO Research Partnerships

- Strengthening links with CIRAD- Département territoires, environnement et acteurs (TERA), CEMAGREF, IRD, the International Center for development-oriented Research in Agriculture (ICRA), and the International Support Group
- Developing new links with the University of Bonn, Institute for Fruits and Horticulture

4. RESOURCE MOBILIZATION

4.1. Proposals funded

3

4.2. Proposals and concept notes submitted

1 rejected, 14 submitted still pending. (See Appendix II)

Appendix I – PE-4 Publications

Books and Journals

Cook, S.E.; Adams, M.L.; Bramley, R.G.V.; Whelan, B.M. 2002. State of precision agriculture in Australia. *In:* Srinivasan, A. (ed.). Precision farming: A global perspective. Howarth Press, NY, USA.

Corner, R.J.; Hickey, R.; Cook, S.E. 2002. Knowledge based soil attribute mapping in GIS: The Expector method. Transactions in GIS. (In review).

Gonzalez, C.; Jarvis, A. 2002. Plants of Tambito 1. Dicotiledonous. A preliminary list. Novedades Colombianas. (Submitted)

Guarino, L.; Jarvis, A.; Hijmans, R.J.; Maxted, N. 2002. Geographic Information Systems (GIS) and the conservation and use of plant genetic resources. *In:* Engels, J. (ed.). Managing plant genetic diversity. CAB International, Wallingford, GB. p. 387-404.

Jarvis, A.; Ferguson, M.; Williams, D.; Guarino, L.; Jones, P.; Stalker, H.; Valls, J.; Pittman, R.; Simpson, C.; Bramel, P. 2002. Biogeography of wild Arachis: Assessing conservation status and settling future priorities. Crop Sci. (In press)

Jarvis, A.; Guarino, L.; Williams, D.; Williams, K.; Hyman, G. 2002. The use of GIS in the spatial analysis of wild peanut distributions and the implications for plant genetic resource conservation. Plant Genet Res Newsl 131.

Jones, P.G.; Gladkov, A. 2002. FloraMap: A computer tool for predicting the distribution of plants and other organisms in the wild. Version 1.01 with 91 p indexed manual. CIAT CD-ROM series, CIAT, Cali, CO.

Jones, P. G.; Thornton, P.K. 2002. Spatial modeling of risk in natural resource management. Conserv Ecol 5(2): 27. [online] URL: http://www.consecol.org/vol5/iss2/art27

Jones, P.G.; Guarino, L.; Jarvis, A. 2002. Computer tools for spatial analysis of plant genetic resource data: 2. FloraMap. Plant Genet Res Newsl 130:6-10.

Jones, P.G.; Thornton, P.K.; Díaz, W.; Wilkens, P.W. 2002. MarkSim version 1. 1 CD-ROM with 74 p manual and index.

Kok, K.; Winograd, M. 2002. Modelling land-use change for Central America, with special reference to the impact of hurricane Mitch. Ecological Modeling 149: 53-69.

Oberthür, T.; Barrios, E.; Cook, S.; Usma, H.; Escobar, G. 2002. Helping soil scientists and Andean hillside farmers to see the obvious about soil fertility management. Agric Ecosyst Environ (Submitted)

Pracilio, G.; Asseng, S.; Cook, S.E.; Hodgson, G.; Wong, M.T.F.; Adams M.L.; Hatton, T.J. 2002. Estimating spatially variable deep drainage across a central eastern wheatbelt catchment, Western Australia. Austr J Exper Agric. (In review)

Reidl, R.S.; Thornton, P.K.; McCrabb, G.J.; Kruska, R.L.; Atieno, F.; Jones, P.G. 2002. Is it possible to mitigate greenhouse gas emissions in pastoral ecosystems of the tropics? Environ Develop Sustain. (In press)

Rippstein, G.; Escobar, G.; Motta, F. 2001. Agroecología y biodiversidad de las Sabanas en los Llanos Orientales de Colombia. CIAT- Centre de cooperation internationale en recherche agronomique pour le développement (CIRAD). CIAT, Cali, CO. 302 p. (CIAT Publ. no. 322)

Skerritt, J.; Adams, M.L.; Cook, S.E.; Naglis, G. 2002. Within-field variation in wheat quality: Implications for precision agricultural management. Austr J Agric Research. (In Press)

Vrieling, A.; Sterk, G.; Beaulieu, N. 2002. Erosion risk mapping: A methodological case study in the Colombian Eastern Plains. J Soil Water Conserv 57:158-163.

Winograd, M. 2002. Natural disasters in Honduras. TIEMPO 43: 11-14.

Winograd, M.; Farrow, A. 2002. Sustainable development indicators for decision making: Concepts, methods, definition and uses. Encyclopedia of Life Support Systems (EOLSS) Publishers Co Ltd., United Nations Educational, Scientific, and Cultural Organization (UNESCO), FR.

Conference Papers and Presentations

Beaulieu, N.; Leclerc, G.; Alvarez, M.; De Wispeleare, G.; Jaramillo, J.; Rubiano, Y.; Fajardo, A.; Muñoz, O.; Peñuela, N. 2001. A proposed framework for using remote sensing imagery to monitor environmental dynamics in support to local planning efforts. Paper presented at the Integrated Natural Resources Management Workshop, 28-31 Aug 2001, Cali, CO. 15 p.

Farrow, A.; Hyman, G.; Larrea, C.; Pérez, S.A. 2002. Informe del taller sobre el Proyecto de Mejoramiento de Métodos de Análisis Espacial de la Pobreza y Seguridad Alimentaria en el Ecuador, 19-20 de Junio 2002, Hotel República, Quito.

Hyman, G. 2002. The CSI/GRID/FAO poverty mapping initiative. Oral presentation at the Geospatial Applications to Support Sustainable International Agriculture (GASSIA) Meeting, 19-31 May 2002, EROS Data Center, Sioux Falls, SD, USA.

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Appendix II. PE-4 Project Proposals 2002

Project Proposal	Person/s responsible	Donor approached	Duration	Total budget required (US$)	Total budget for PE-4 (US$)
1. Challenge Program on Water and Food (CPWF)	Simon Cook, Ignacio Sanz	IWMI Accepted	5 years	82,000,000	3,500,000
The CGIAR CPWF is an ambitious research, extension, and capacity building program that will significantly increase the productivity of water used for agriculture. It is an 18-member consortium composed of five CG/Future Harvest centers, six National Agricultural Research and Extension Systems (NARES), four Agricultural Research Institutes (ARIs), and three international NGOs. The program's aim is to allow more food to be produced, with the same amount of water that is used in agriculture today, as populations expand over the coming 20 years. This is to be done in a way that decreases malnourishment and rural poverty, improves people's health, and maintains environmental sustainability. There are clearly defined roles for each consortium member. CG centers lead thematic groups. The Program consists of 5 themes and at 12 benchmark sites. CIAT has been nominated to lead Theme 2: Multiple Use of Upper Catchments, with Simon Cook of PE-4 nominated coordinator. The objective is to improve sustainable livelihoods for people who live in, and downstream of, upper catchments through significant, unambiguous improvements of water productivity. This will be achieved through comparative research at benchmark sites (e.g., benchmark basins in the Andes, Honduras, and the Mekong) that will identify opportunities and incentives for measurable improvements in use of the water resource and by enabling the learning processes that influence groups of people to adopt them.					
2. Targeting comprehensive rural poverty reduction campaigns for Mesoamerica that integrate agricultural research and technology	Reed Hertford, Simon Cook	World Bank Rejected	1 year	270,000	90,000
This proposal is to develop a "uniform data set" for the Meso-American Region for two points in time (around 1990 and 1999), and to perform analyses of those data from which broadly valid conclusions about the determinants of poverty can be derived that will guide comprehensive regional rural poverty programs. Most importantly, as a result of the project proposed here, it will be possible to include efforts to generate improved pro-poor agricultural technologies in comprehensive rural poverty programs. Too, more comprehensible and useful indicators will be designed and estimated, which should help orient public policy and the analysis of poverty in the region.					
3. From small things big things grow: Reducing the risk of land use change in upland farming systems by calibrating process research with generally available terrain and climatic information	Thomas Oberthür, Simon Cook	IWMI Comprehensive Competitive Research Grant Scheme Pending	1 year	188,600	87,500
This project will enable communities in traditional upland farming systems to cope sustainably with change that is forced upon them by global economic, political, and biophysical drivers. Through an innovative data filtering approach, using widely available digital elevation models (DEMs) to "weld" knowledge of scientific processes with topographic information, research will demonstrate how to identify "hot spots" and low-risk areas in a form that is scientifically consistent, but of immediate meaning to farmers, allowing them to identify trade-offs thereby permitting pro-active responses. The conducted research will enable upland farmers to establish sustainable livelihoods by identifying opportunities to increase water productivity through environmentally sound intensification and extension of current farming systems.					
4. Maguaré: Empowering Latin American communities to harness fair-trade opportunities through information networking	Thomas Oberthür	European Commission Pending	3 years	4,200,000 EUROS	700,000 EUROS
Maguaré, an ancient instrument, linked remote Indian communities over long distances with its call for "la fiesta de las comunicaciones". This project will enable Latin American farming communities in fragile hillsides and biodiversity hotspots to fair trade valuable, environmentally acceptable products in local, regional and global markets. It will do this by consolidating a telecentre-based network to link farmer to farmer, farmer to expert, and farmers to local and international buyers. The function of the network will be to define what products can be sold and grown to expand or contract production in line with conditions that are socially, environmentally and economically acceptable. Existing network infrastructure will be used wherever possible to implement a two-tier architecture of broadband satellite and telephone or wireless modem connectivity.					

Continued.

PE-4 Project Proposals (continued)

Project Proposal	Person/s responsible	Donor approached	Duration	Total budget required (US$)	Total budget for PE-4 (US$)
5. Local knowledge, widespread impact: Enabling farmers in Latin American hillsides to diversify safely into fruits through ecological correlation	Thomas Oberthür, Andy Jarvis, James Cock	BMZ Pending	3 years	1,100,000 EUROS	600,000 EUROS
We aim to accelerate the adoption of fruit trees in hillside farming systems within geographically widespread, but environmentally similar areas, to alleviate poverty through diversification. We will do this by calibrating existing knowledge of fruit tree performance with local ecological knowledge about wild fruit species, fallows, forests, etc. to provide indicators of eco-physiological similarity. The purpose is to develop robust methods of providing relevant yet scientifically sound advice about opportunities and risk of adopting specific fruits in farming systems, thereby matching the diversity of fruit species with the diversity of habitat in Latin American hillsides.					
6. Reducing the risk of land use change in the Mekong uplands by diagnosing agronomic water management hot spots	Thomas Oberthür	IWMI Comprehensive Competitive Research Grant Scheme Pending	2 years	188,600	77,500
The project involves three distinct, but closely related, parts. The first is a global analysis where risk to land use change is assessed using documented research from detailed watershed studies. Having identified processes and systems components of land use change on a broad level, the second part of the project involves the identification of those processes that can be modeled using existing information and analytical techniques. These processes are then spatially and temporally modeled within a GIS to quantify risks to water productivity in large areas that arise from land The project will accelerate the adoption of sustainable intensification by poor farmers in complex tropical uplands environments by reducing the risks to water-increased water productivity associated with new land use practices. The new knowledge will sharpen awareness of the variable performance of land use options, and ultimately farmers will benefit from the more rapid implementation of intensification enabled by greater certainty about their effect.					
7. Reducing the risk of global climate change on local food production and environmental services by merging farmers' and scientists' insight	Thomas Oberthür, Rainer Wassman (Frauenhofer Institut), Andy Challinor (Reading)	VW Foundation Not yet submitted	2 years	Not defined	Not defined
It is widely accepted that global climate change will significantly change the conditions faced by farmers in most regions of the world. In many places, risks will be exacerbated; in some, they may be reduced. In all cases, farmers must adapt or lose. We propose research that aims first at revealing risks to food production and environmental services due to global climate variation at agronomically relevant geographical scales. Broad-scale predictions of climate change have already been produced for many areas, but these are unlikely to stimulate farmers into making the necessary adjustments because of a lack of detail and lack of communicative ability needed to take practical action. By coupling simulation modeling of climate with participatory resource mapping, this project will help organize the observations farmers already have about the variable risks they face. Through calibration with prior extreme events, a parallel approach may confirm their expectations of future conditions; hence stimulate adaptive change towards a more resilient system. Second, quantified risks will be used to design potential new cropping systems that attempt to accommodate production and environmental services. These suggested scenarios of cropping systems are then evaluated through economic modeling and assessed with local land managers.					

Continued.

PE-4 Project Proposals (continued)

Project Proposal	Person/s responsible	Donor approached	Duration	Total budget required (US$)	Total budget for PE-4 (US$)
8. Conservation of soil biodiversity in Southern Honduras	Thomas Oberthür, Edmundo Barrios; Natasha Pauli, Arthur Conacher (University of Western Australia)	BP Conservation Fund Pending	1 year Pending	17,000	Not defined
The study will investigate soil macroinvertebrate communities in different land use areas. A wide array of organisms are expected to occur, including earthworms, ants, beetles, termites, centipedes, millipedes, spiders, and isopods. Soil communities are extremely diverse, yet they are poorly understood, and in great need of further study.					
9. Improved mapping and spatial analysis of food security and poverty in Ecuador	Andrew Farrow, Manuel Winograd, Gregoire Leclerc, Steffen Schillinger	CSI/FAO/GRID Accepted	1 year	220,000	33,000
Through the application of innovative spatial analysis, this project will identify the current condition, environmental drivers and sensitivity to external shocks of poverty and food security in Ecuador. Our analysis will complement existing studies and add value to them by focusing on geographical processes and patterns. We will analyze food security and poverty conditions, the driving forces behind these problems, and vulnerability and risk of affected sectors of the population. We will synthesize our results into a model of poverty and food security that can be used to simulate future scenarios. We will share our work through an Internet-based communication strategy that includes dynamic mapping on the web and links to multiple networks of stakeholders interested in food security and poverty problems.					
10. Hotspots of climatic change in the tropics: Impacts on agricultural systems and poor people in the tropics	Peter Jones, Phil Thornton (consultants)	Included in CGIAR Global Challenge Program on Climate Change Proposal Pending	5 years	2, 600, 000	Not defined, but about half
The project purpose is to increase food security and decrease poverty among the rural poor in the face of climate change in the coming decades. To achieve this, we will identify areas of the tropics where households are particularly vulnerable and formulate possible adaptations that can help to mitigate or exploit the increased temperatures and changing patterns and variability of rainfall that such households may experience. This analysis will provide information for a wide variety of impact assessments. It will help the IARCs assess how farming systems may change. This will allow more appropriate interventions to be better targeted, help inform policy makers of possible shifts in the patterns of production, and help give indications of where policy and infrastructure adjustments might be needed in the future. It will also assist in redirecting breeding efforts and natural resource management research activities.					
11. Farming futures under climate change: Impacts on agro-ecosystems and poor people in the tropics	Peter Jones, Phil Thornton (consultants)	Not defined	3 years	Not defined	Not defined
The project involves two distinct, but related, parts. The first is a global analysis where system vulnerability to climate change (and human population change) is assessed, using a broad-brush approach. Having identified some hotspots on a broad level, the second part of the project involves the use of existing systems models to assess what impacts climate change may have at the household level, and to investigate management and technology options for coping with them. The output of this project will provide information for a wide variety of impact assessments. Information on likely changes in ecosystems will allow more appropriate interventions to be better targeted, help inform policymakers of possible shifts in the patterns of production, and help give indications of where policy and infrastructural adjustments might be needed in the future. It will also assist in redirecting breeding efforts and research activities in natural resource management.					

Continued.

PE-4 Project Proposals (continued)

Project Proposal	Person/s responsible	Donor approached	Duration	Total budget required (US$)	Total budget for PE-4 (US$)
12. Farming Futures Lite: A tool to target the investment in agricultural research to counter the effects of global climate change	Peter Jones, Phil Thornton (consultants)	USAID and IDRC Pending	18 months	150,000	Not defined, but about 100,000
The CGIAR system has underway a major system-wide project on climate change and how it affects agriculture in the tropics. Within this project is a multi-million dollar project called Farming Futures to model these effects and feed the information back to CGIAR and national scientists to assist them in formulating research goals and priorities. However, the short-term need is to help in the first stages of this project—to sort out where the first priorities are. This is where the Farming Futures Lite project can help. This will take a restricted range of four to five typical crops and run the same simulations as have been done for a maize example. These would include other cereal, legume, and root crops to get an approximate response to the environmental change we can expect. From that we could construct index maps of where we could expect the major problems, and, from these, target the efforts of a very short-funded CGIAR system to where they could produce the most good.					
13. Impact of climate change on the centers of diversity of wild relatives of major crops: long-term management of plant genetic resources in Latin America	Peter Jones, Andy Jarvis, Luigi Guarino	Included in CGIAR Global Challenge Program on Climate Change Proposal Pending	Not defined	Not defined	Not defined
The conservation of biodiversity is important in terms of food security and poverty alleviation; and may even be considered a moral obligation. Efficient conservation of germplasm and strategic location of protected areas will allow future generations to benefit from continuing crop improvement. National programs will be strengthened in their capacity to manage their genetic resources, permitting future economic benefits for countries in the developing world and in the inevitable global exchange of genes. The modeling component will provide scenarios for the potential impacts of climate change on plant genetic resources in Latin America. Specific action plans will be identified for their efficient management. Close collaboration with Latin American national programs will be required as they will need to act on the results in the re-location of species to refugia and in *ex situ* conservation of important germplasm. This germplasm may prove important in the generation of improved cultivated varieties that are less susceptible to losses in yield as the climate changes.					
14. Understanding the implications of global climate change for pest and disease management in the tropics	Peter Jones, Phil Thornton	Included in CGIAR Global Challenge Program on Climate Change Proposal Pending	Not defined	Not defined	Not defined
Many insect pests and disease vectors, as well as bacterial and fungal diseases are strongly influenced by climate. This project will use FloraMap to map the environmental range of pests and diseases of CGIAR-mandated crops, and estimate how they will react to GCC. Outputs will include descriptions of GCC on the population dynamics of the effect of pests and diseases, such as cassava green mite, whitefly, anthracnose in common beans, web blight in common beans, and vectors of animal diseases such as tse tse fly in Africa. This analysis will provide information for a wide variety of impact assessments. It will help the IARCs assess how IPM in farming systems may change. This will allow more appropriate interventions to be better targeted.					

Continued.

PE-4 Project Proposals (continued)

Project Proposal	Person/s responsible	Donor approached	Duration	Total budget required (US$)	Total budget for PE-4 (US$)
15. Dry times: Improving common bean for drought resistance in poverty-endemic tropical environments	Peter Jones, Phil Thornton	Included in CGIAR Global Challenge Program on Climate Change Proposal Pending	4 years	1,500,000	Not defined
The proposal will launch an international effort to improve bean for drought resistance, combining the expertise of scientists on three continents, which has not been attempted before in common bean, and which will encourage exchange of germplasm. For example, varieties developed at medium latitudes in Mexico could be useful at similar latitudes in southern Africa. Red-seeded varieties for Central America would be useful in tropical eastern Africa. The proposal will maintain the advances in disease resistance while recovering drought resistance in bean types that are acceptable to farmers with regards to grain type, plant habit and growth cycle. Molecular markers will be employed in novel breeding schemes to maintain resistance genes in populations and lines, while greater attention will be placed on drought selection by both traditional and molecular techniques. Combining gene tagging with physiology and GIS analysis of drought patterns will permit more precise definition of the genetic basis of physiological traits responsible for drought resistance and the best ways to deploy them.					
16. Dynamic access to information on population, agriculture, and environment	Glenn Hyman	IDB Pending	1 year	195,027	88,880
The proposed project promotes visualization of population, agriculture, and environmental data and maps using the Internet and registered spatial data clearinghouse nodes for Central American institutions. This portal will help Central American decision makers and others outside of the region become more aware of the value and benefits of a Spatial Data Infrastructure to encourage data sharing and compatibility. At the same time, it will enable dynamic, on-line integration of socioeconomic data with a range of biophysical and political themes, such as administrative boundaries, watershed boundaries, electoral boundaries, climatic zones, and flood zones.					
17. Assessment of development of water system for irrigation in Chile	Jorge Rubiano, Simon Cook	IWMI Comprehensive Competitive Research Grant Scheme Pending	2 year	137,000	35,000
The aim of this project is to document the evolution of water systems, water markets, and their role in alleviating rural poverty in the Limarí Basin, Chile. We will make use of quantitative (spatial regression analysis of socioeconomic and irrigation scheme indicators) and qualitative (historical analysis, surveys, in-depth interviews, policy analysis) methods. Expected results include (1) an inventory of public expenditures in irrigation infrastructure and subsidies; (2) the description and synthesis of the evolution of (a) economically active population; (b) poverty indexes; (c) distribution of water rights, (d) government policies on water resources and agricultural development, and (3) Guidelines and recommendations aimed at policymakers and decision makers for improving public policy on irrigation water systems and rural poverty alleviation. Hence, we will illustrate the general problem of inequitable distribution of irrigation benefits using a well-documented case study.					
18. Automated identification of faunal indicator species of soil fertility using high resolution kite-based aerial photography	Andrew Jarvis	COLCIENCIAS Accepted	1 year	6,000	3,700
This research will allow producers to better manage soil fertility on hillside farms, based on the soil macrofauna. We will develop a solid and transferable methodology that combines high-resolution images with ground truthing for the rapid identification of groups of macrofauna that indicate soil fertility. Our method will minimize the time and resources required for follow up in the field and will permit producers to make opportune and correct decisions about practices in soil fertility management.					