

ANNUAL REPORT 1995

RESEARCH PROGRAM ON SUSTAINABILITY IN AGRICULTURE (REPOSA)

(CATIE-WAU-MAG)

COSTA RICA

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I. Introduction

1.1 *Organization of the program*

This document serves the dual purpose as the bi-annual report for the final six-month period of 1995 and as the 1995 annual report of the Research Program on Sustainability in Agriculture (REPOSA), formerly known as the Atlantic Zone Program (AZP). During the course of 1995 the program changed its name from AZP to REPOSA in view of the fact that a considerable part of project activities is now geared towards the zone of Guanacaste. REPOSA is a cooperation between CATIE, Wageningen Agricultural University (WAU, The Netherlands), and the Costa Rican Ministry of Agriculture and Livestock (MAG). It operates under official agreements with CATIE and MAG and has signed memoranda of understanding with numerous other organizations in Costa Rica, including CORBANA (National Banana Corporation), DGEC (General Directorate for Statistics and Census), FAO (Food and Agricultural Organization of the United Nations), IGN (National Geographics Institute), and MIRENEM (Ministry of Natural Resources), among others. REPOSA maintains active working relationships with both the UCR (University of Costa Rica) and the UNA (National University). In addition, REPOSA maintains contacts with international research groups like ICASA (International Consortium for Agricultural Systems Analysis) and with inter-university research collaborations such as the one on the effects of changing land use on global gas emissions (WAU, La Selva Biological Research Station, and University of New Hampshire).

REPOSA is financed entirely by Wageningen Agricultural University under its Sustainable Land Use in the Tropics program, sub-program Sustainable Land Use in Central America (SLUICE). Together with the Management of Natural Resources in the Sahel (VF-SAHEL) and the Sustainable Land Use and Food Security (DLV) sub-programs, SLUICE makes up the Sustainable Land Use in the Tropics program. Conditional on satisfactory performance, SLUICE is financed by WAU until December 31 1998, with a provisional annual operating budget of some DFL 680,000.

Program staff consists of three core staff members from WAU (one economist/coordinator, one soil scientist/GIS specialist, and one agronomist/agro-ecologist); and eight Costa Rican staff in Guápiles. In addition, REPOSA occasionally hires temporary staff. Three Dutch PhD students are involved in specific parts of the research, whereas two Costa Rican PhD fellows are associated with the program as well. In addition, research collaboration with CATIE is achieved through a liaison person between REPOSA and CATIE (a forage and livestock specialist based at CATIE). At any given time, a number of students from both the Netherlands (mainly WAU but also from other Dutch universities and polytechnical institutions) and Costa Rica (mainly CATIE and UNA), under supervision of one of the core staff members, actively participate in the research.

REPOSA operates mainly out of Guápiles where it is located on an experimental station of MAG, but maintains offices in CATIE as well.

1.2 *Background and justification of REPOSA research*

Agricultural policies and economic incentives can be important tools to achieve a more sustainable use of natural resources. Policies are defined by national or regional governments, but the ultimate decision on how to use agricultural land is made on individual farms. Different farms may respond differently to certain policies or incentives. These differences in responses are related to differences between farms in physical possibilities, in socioeconomic conditions, and in objectives and preferences of persons managing the farm. Since policy makers need information about the trade-offs between income and sustainability-related goals in an ecological sense, they need to be able to evaluate alternative land use policy options from various perspectives, requiring analytical methods which take simultaneous account of socio-economic, edaphic and agronomic factors. Consequently, during the past four years, REPOSA has been spending major efforts and resources in the continuous development and refinement of a multidisciplinary methodology which can assist policy makers in evaluating alternative land use options while allowing for improved analysis of the aggregate effects of alternative policies at the (sub)regional or national level.

1.3 *The USTED methodology*

Even though land use has a clear spatial dimension, until recently the available literature did not offer a methodology that allows flexible georeferencing of inputs to, and outputs from, land use evaluation models. The methodology for land use evaluation developed at REPOSA, denominated *USTED* (*Uso Sostenible de Tierras En el Desarrollo*; Sustainable Land Use in Development), intends to fill this hiatus and explicitly includes different levels of analysis and decision making in the agricultural system, *i.e.*, field, farm and region. *USTED* is based on a modular approach to the integration of different models and data bases (fig. 1). While integrating various techniques, *USTED* is centered around a linear programming (LP) model which maximizes farm income subject to various resource- and sustainability-related constraints. The latter are flexible allowing the methodology to be used for assessing trade-offs between income and ecological sustainability objectives. The methodology also includes a Geographical Information System (GIS) which is used to store geo-referenced data and to visualize land use options through the generation of maps.

By grouping individual farms into a number of farm types which are separately dealt with in the LP model, it is explicitly recognized that ultimate decisions regarding land use are made at the farm level. Farm types are obtained mainly on the basis of size and soil distribution. Different options for land use are defined as combinations of soil groups and land use types with fixed input-output technologies, called LUSTs (Land Use Systems under a defined Technology).

The concept of sustainability in an ecological sense forms an integral part of the methodology and is measured through a limited number of indicators, including depletion of the soil nutrient stock and a biocide environmental impact index. Policy interventions are translated into changes in the socio-economic environment and/or resource endowments, or adjustments in sustainability requirements.

1.4 *1995 research focus*

After some three years of data collection and methodology development, and successful operationalization of *USTED* at the level of the *Neguev* settlement (some 5,000 ha) in 1994 (see a special issue of the Netherlands Journal of Agricultural Science, Volume 43, Number 1, published in April 1995), during the course of 1995 a number of papers (both in English and in Spanish) were developed in which the *USTED* methodology is explained and illustrated with various scenarios for *Guacimo* county in the Atlantic Zone. The scenarios included, among others, output and input price scenarios as well as (ecological) sustainability related scenarios, the latter allowing a quantification of trade-offs between income and ecological sustainability objectives. These papers were presented at both national and international conferences, sometimes resulting in book chapters and/or abstracts in refereed journals. Subsequent work in 1995 focused on the following elements:

- (1) operationalization of *USTED* for the Atlantic Zone as a whole, including (1a) upscaling of the methodology towards the regional level, and (1b) inclusion of a number of animal production systems with given technologies (APST's);
- (2) initiating work on demand in an adapted version of *USTED* (hereafter referred to as *USTED* 1996);
- (3) operationalization and applying *USTED* in a low data environment in the province of Guanacaste through (2a) producing a soil inventory, and (2b) initiating crop data collection;
- (4) improving the sustainability-related factors in *USTED*; and
- (5) other activities.

2. Research themes

2.1 *Structure of the research*

REPOSA research is divided into four themes, each of which contains a number of individual projects. Each theme corresponds to a major objective of the program, *i.e.*, refining the methodology already developed for the Atlantic Zone; carry out a validation of the methodology in the Guanacaste area; extend the methodology toward higher geographical aggregation levels; and study the interaction between certain global processes, such as climatic change and emission of greenhouse gasses, and land use.

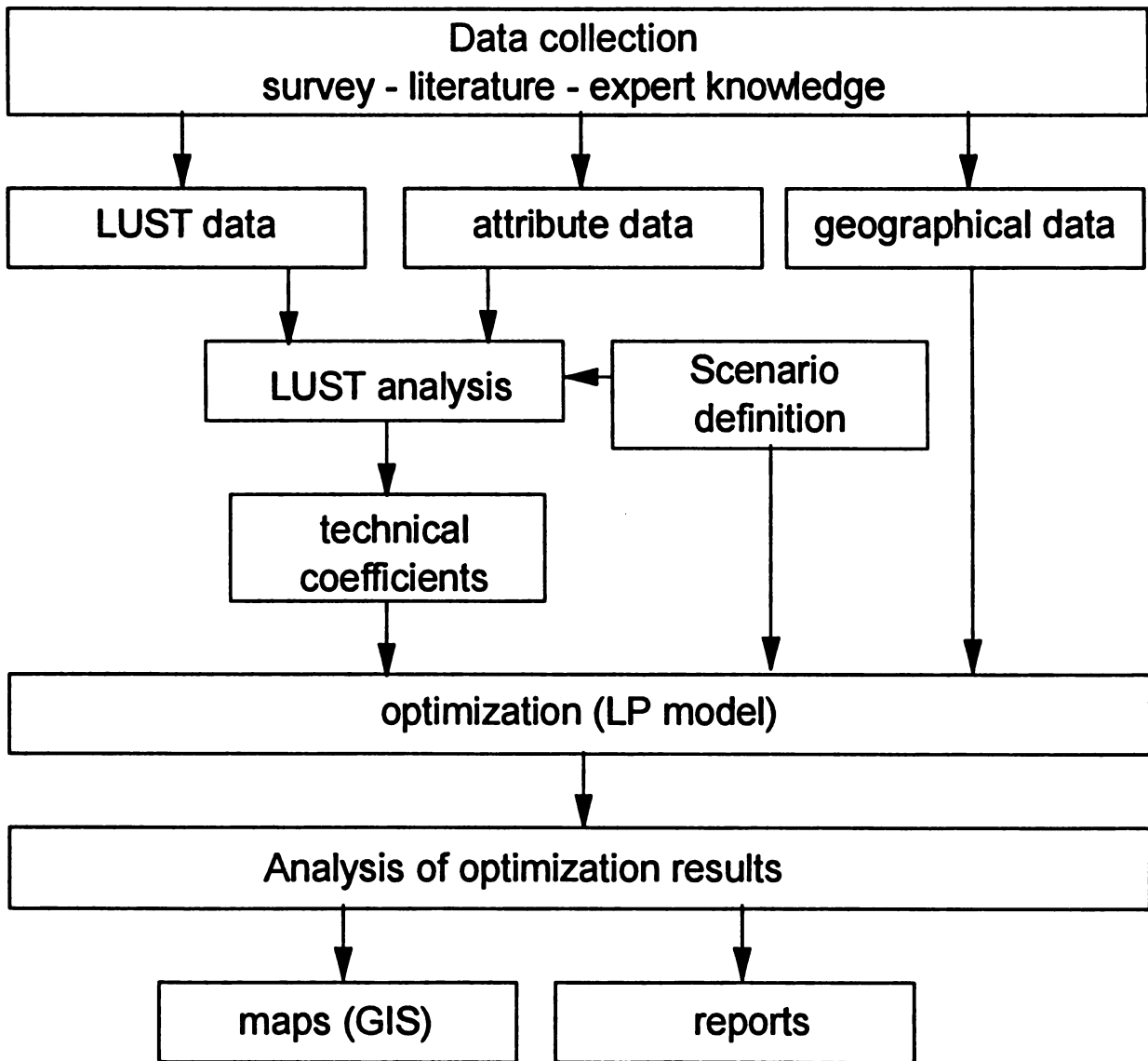


Figure 1. Structure of USTED

2.2 *Achievements of individual projects*

Theme I: Refining the methodology for regional land use planning in the Atlantic Zone of Costa Rica

I.1 *Application of soil-and landscape data for actual and potential land use evaluations in the Atlantic Zone of Costa Rica*

Even though, as of 1995, a considerable part of REPOSA's activities is geared towards (part of) the province of Guanacaste, with the main purpose of applying the *USTED* methodology in a low data environment, REPOSA continued to work in the Atlantic Zone area as well where it spent major efforts towards further development and refinement of *USTED*. For example, the *USTED* methodology was adapted and now can include animal production systems (called APST's) in a manner that is fully complementary with that of crop production systems (LUST's). In close cooperation with CATIE, APST's were developed in 1995 for the Atlantic Zone for two systems, *i.e.*, one for exclusively milk production enterprises and one for dual purpose (milk-meat) enterprises. The two M.Sc level theses associated with this research will be completed by March 1996. The MODUS software was adapted to deal with APST's and to calculate the appropriate technical coefficients (related to feed balances). The LP model was adapted to deal with APST's (feed balances) and economic sub-regions.

Some work has been done to improve upon the biocide index, by evaluating the human health costs associated with the use of biocides in banana cultivation, which turned out to be trivial. In addition, a rough assessment of the environmental effect of the use of biocides has been made through estimates of biocide leaching with a simple linear equilibrium type model.

Past soil-related research in the Atlantic Zone was summarized and updated and will be published in the CATIE Technical Series in early 1996.

The geographical data base has been summarized and updated and is published in an atlas for the Atlantic Zone.

I.2 *Landscape turnover rates in the footslopes of the Atlantic Zone of Costa Rica*

This project focusses on the assessment of erosion and sedimentation of rivers in the Atlantic Zone as a function of long term processes as tectonics, volcanic activity, and climate. Fluvial processes have determined to a large extent the spatial patterns of soils in the Atlantic Zone. The aim of the project is to explain the origin of these patterns as a function of fluvial dynamics.

The footslopes of the Central Cordillera in the Atlantic Zone of Costa Rica are among the most dynamic fluvial systems in the world, due to high precipitation, active seismic and volcanic activity and rapid subsidence of the adjacent foredeep basin. Volcanic eruptions, earthquakes and extreme meteorological events contribute to the highly episodic character of fluvial dynamics. In order to allow detailed analyses of the processes involved, 3-D numerical process models for the simulation of long term fluvial dynamics were developed during 1995. A new aspect of the

developed models is the emphasis on the simulation of spatial sedimentation patterns in an alluvial fan environment. The model is currently being calibrated and refined.

I.3 *Methodological aspects of explorative land use studies*

In collaboration with the Department of Mathematics and the Department of Theoretical Production Ecology, a post-optimization approach to deal with uncertainty in IMGLP models is being developed. Given particular land use scenarios (called reference scenarios) generated with the IMGLP model, alternative land use scenarios are generated which differ only slightly in terms of objective values, though significantly in terms of land use. In a next step the reference and alternative scenarios are compared taking into account the uncertainty in technical coefficients using a Monte Carlo simulation approach.

A second topic in this project concerns the effect of aggregation of spatial and temporal information in land use studies. Before or after the land use evaluation, before or after quantifying input-output combinations and before or after integrating information in LP models spatial and temporal data can or must be aggregated. Consequences of such aggregations are investigated in various case studies. Though often hindered by practical limitations (computing time, size of LP models, etc.), the general rule 'first calculate, then aggregate' seems to be applicable also for aggregation issues in land use studies. In the project, aggregation errors in various steps in land use studies are quantified and related to curvi-linear relations in calculation procedures.

I.4 *Development of a regional ecological land use model in Costa Rica*

An exploration of long term land use options is being carried out using a multiple-goal LP (MGLP) model. Bio-physical possibilities and constraints are confronted with the various policy views. The time horizon of the study is at least 25 years; current socio-economic, infrastructural and farm structural constraints are not included in the model. Two methodological aspects get special attention within this project: i) how to deal with uncertainty in technical coefficients; ii) what is the added value of using a multi-period MGLP model, compared to a single-period model. In 1995 the description of land use activities by technical coefficients was finished. For technical coefficients concerning nutrients and biocides ranges of values were determined, indicating the uncertainty due to lack of knowledge of underlying biophysical processes or due to lack of data for quantification of these processes. These uncertainties will be taken into account explicitly during model runs. A conceptual multi-period MGLP-model and a one-period MGLP-model were developed. These models will be compared to determine the added value of a multi-period model.

I.5 *Modification of soil processes by mulching in the humid tropics*

The palm heart mulching experiment was concluded at the end of 1995. Monitoring of soil physical characteristics was discontinued due to logistical problems. Measurements of biomass production were intensified to produce data for a crop development model. Experimental data indicate that transfer of mulch involves large

flows of Nitrogen, but without an effect on crop production. This has important implications for input strategies of palm heart farmers.

- I.6 *Determinants of sustainable systems with perennials in the humid tropics*
A start was made with descriptions of the LUSTs coffee and mango. Other perennials to be followed.
- I.7 *Adaptation of population dynamics and nutritive value of forage in tropical countries*
Field trials to test the potential of two specific tree species (*Gliricidia* and *Erythrina*) combined with a promising grass-legume combination (*B. brizantha* and *A. pintoi* mixture) continued, in the context of the PhD research of Sergio Abarca of MAG. An economic evaluation of improved pasture technologies in the Atlantic Zone of Costa Rica was conducted which concluded that even though replacing the native grass vegetation with a mixture of the grass *B. brizantha* and the legume *A. pintoi* is very profitable, the same mixture in combination with two legume trees (*Erythrina berteriana* and *Gliricidia sepium*) is not.
- I.8 *Integration of trees and forests in farming systems*
Arthur van Leeuwen, PhD. candidate in the Department of Forestry and responsible for this project, visited REPOSA for some last minute data collection. A book was published in the CATIE Technical Series. Work on this project slowed down with van Leeuwen's departure to Nicaragua at the end of 1995.
- I.9 *Economic aspects of land evaluation and land use planning*
Transportation cost models were developed for the Atlantic Zone which will be used in the estimation of location-specific farm gate prices, to do away with the assumption that farmers face price vectors that are independent of their geographical location which is no longer true at higher aggregation levels where prices for both outputs and inputs will vary depending on (mainly) transportation costs. Rob Schipper continued to work on his PhD thesis which will be completed by mid-1996. Work on the estimation of food demand models, aimed at estimating price elasticities needed to incorporate downward sloping demand curves into the LP model, was initiated.
- I.10 *Sustainable production and agricultural households response reactions in the Atlantic Zone of Costa Rica*
Collaboration with the DLV program was less intensive compared to 1994, mainly due to an increased focus of DLV on other countries for 1995. Nevertheless, one UNA staff member received training at WAU. As of 1996 DLV is expected to continue its work on Costa Rica, with particular reference to aspects of further assisting in the development of USTED, from the current models (which are of an exploratory type) towards policy-type models. Funding for the UNA/DLV project materialized at the end of 1995, with work expected to start in March 1996 with input from UNA (three researchers) and Wageningen (Department of Development Economics).

Theme II: Rapid low-input data validation of USTED in the Guanacaste area

II.1 *Basic data collection for integrated land use analysis focused on sustainability evaluation*

Work to operationalize *USTED* for (the larger part of) Guanacaste province started at the end of 1994 with the initiation of a soil inventory specifically geared towards the requirements of *USTED*. With the specific goal in mind to complete the inventory within the time frame of one year, methods used included a detailed study of available aerial photographs and analysis of building blocks rather than individual layers of each soil horizon. Soil samples were sent to Wageningen for analysis which will be completed by the end of 1996. A soil map for Guanacaste which can be used operationally in *USTED* will be available by March 1996.

Data collection for LUST's and APST's in Guanacaste started in 1995 with some work on mango and coffee. However, it is anticipated that significant more data are needed for the construction of LUST's for these crops. Work on other crops as well as on APST's for Guanacaste will start in 1996.

II.2a *Soil property characterization and sustainability parameter definition in the Guanacaste area*

Soil sampling continued with soil samples sent to WAU for analysis which will be finished only in the course of 1996.

II.2b *Climosequence on volcanic soils (semiarid-perhumid)*

Peter Buurman, Toine Jongmans Ed Meijer, and student Marjon Plantinga visited the Atlantic Zone and the Guanacaste area. Representative climo-sequences were selected and described. Chemical, physical, and micromorphological samples were taken from representative profiles at these climo-sequences. Within the scope of a doctoral thesis, the Turrialba climo-sequence is worked out by the student Karin de Boer (deadline September 1996). Toine Jongmans visited the INRA, station Science du Sol, Versailles, France, to collect Electron microscopy data (TEM, SEM) from tropical volcanic soils.

II.3 *Elaboration of farm and regional land use scenarios for the Guanacaste area using the USTED methodology*

This project has not yet been initiated.

Theme III: Integrating regional planning scenarios for national purposes

III.1 *Integrating and comparing driving variables in the land use change at LU, LUS, regional and national levels*

The project resulted in the development of concepts for handling the highly dynamic

features of land use change and its drivers for a small country (Costa Rica) at different spatial scales. An analysis of Costa Rican land use/cover system distribution and their dynamics at six different spatial scales demonstrated that the human/biophysical dimensions of land use/cover systems are scale dependent. Each land cover has its own specific set of human and biophysical scale related drivers. Most important Costa Rican drivers or their related proxies were urban and rural population, agricultural labor force, infrastructure, relief, soils, and climate. Most changes in land use from 1973 to 1984 were related to changes in population density and their distribution and confined to certain biophysical conditions. The reconstructed drivers were simulated and integrated within a dynamic model framework, Conversion of Land Use and its Effects (CLUE). The CLUE approach was applied successfully for Costa Rica using 913 (0.1°*0.1°) grids. It can be concluded that the CLUE modelling framework is suitable to construct operational multi-scale land use/cover change models. CLUE allows geographically explicit modelling of the effects of changing demographical and biophysical driving forces or their proxies on land use/cover changes. By using different aggregation scales it can be demonstrated that local, regional and national trends can have opposite effects and results. The multi-scale aspect of the model allows the simulation of realistic system dynamics demonstrating the essential role of both top-down and bottom-up effects and processes. The multi-scale properties of the CLUE-CR model seem to stabilize model dynamics within realistic domains despite the limited data on which the model is based. There are no methodological constraints to scale CLUE down and/or up and to link up with regional land use planning exercises and global climate change assessment studies. For the moment data limitations prevent such an exercise. The results of the CLUE model have been published as 5 scientific papers and will now be further elaborated and validated in a series of two follow-up projects. Future research will attempt to model human (demographic and socio-economic) and biophysical drivers of global land use/cover in an integrated and multi-scale effort. A follow-up project has been funded to combine the CLUE and IMAGE methodology to model land use/cover dynamics at various scales, allowing comprehensive quantitative perception of the model performances and the relations between driving forces, scale and land use dynamics and socio-economic feedbacks.

III.2 *Introduction and implementation of USTED in national land use planning through interaction with user groups in Costa Rica*

Work was initiated on the preparation of course materials for an USTED course which will be held for Costa Rican user groups in the first half of 1996.

III.3 *Market-driven incentives to change cropping patterns or land use systems*

A book on agricultural marketing in the Atlantic Zone of Costa Rica was completed and approved for publication by CATIE in its Technical Series.

Theme IV: Global level

IV.1 *Land use and emission of greenhouse gasses*

After being honored by WOTRO at the end of last year, work on this project, which will study the effects of changes in agricultural land use on emission of greenhouse gasses (N_2O), has started in early 1995 with the hiring of an OIO who divides his time between the Netherlands (WAU), Costa Rica (REPOSA and La Selva Biological Station) and the U.S.A. (University of New Hampshire). The project focusses on the effects of land use change on the emission of nitrous oxide (N_2O). These effects will be quantified with GIS-based simulation models. Land use types of interest are: primary and secondary forest, pastures, and banana plantations. Ultimately, nitrogen trace gas emissions may be translated into a sustainability indicator.

In April and May 1995, the OIO visited the REPOSA team in Guápiles, the modelling group at the University of New Hampshire, and the field team at La Selva. This latter group provides the N_2O flux data. Contacts with a research group from the University of Wyoming were also established. This group recently started a similar land use/trace gasses project, and will also benefit from the USTED geographic data base.

In 1995, most efforts were put into the development of spatial scaling approaches and the adaptation of the trace gas simulation model (DNDC) to the Costa Rican soil conditions and land use types.

IV.2 *Integration of USTED-IMAGE-BIOME*

This project has not yet been initiated.

III. External contacts and visits by REPOSA/UAW staff

III.1 Visits to partners

On January 11, Hans Jansen visited CATIE to meet with Rubén Guevara (DG) and Asefaw Tewolde (Head of the Postgraduate School) mainly to sort out problems (perceived by CATIE) with Muhammad Ibrahim.

On February 1, Hans Jansen visited CATIE to meet with Fernando Ferrán (Head of External Relations) and Luis Coto (Head of Human Resources), to sort out financial problems.

On February 15, Don Jansen gave a presentation on the use of Gaussian integration to calculate photosynthesis in crop growth simulation models at the 9th symposium on the application of mathematical methods at the Turrialba site of the UCR.

During February 20-24, Don Jansen visited Wageningen to discuss working relationships. Participated in a meeting of the Costa Rica Steering Committee during which contributions of the various participants in SLUICE were discussed.

On March 1, Hans Jansen visited CATIE to present the PZA contribution to the CATIE 1994 Annual Report.

On March 14, Jetse Stoorvogel and Hans Jansen gave a presentation of USTED to CATIE staff and students.

On March 15, Hans Jansen and Jetse Stoorvogel visited the UNA in connection with a student's thesis defense.

On April 5, Hans Jansen, together with Johan Bouma and Bert Boerrigter, paid a courtesy visit to Rubén Guevara, DG of CATIE.

On April 18, Jetse Stoorvogel and Jacomijn Pluimers organized a small seminar at the "Proyecto de Plaguicidas" of the UNA and presented REPOSA work on biocide leaching.

On May 3, Hans Jansen met with Carlos Murillo, Director of the MSc. program in Economics of the UNA, to discuss the joint research proposal with DLV.

On May 24, Hans Jansen met with Fernando Ferran (Head of External Relations) and Rubén Guevara (DG) of CATIE, to sort out financial misunderstandings.

Hans Jansen visited Wageningen between May 30 and June 1, to discuss the succession of Don Jansen; to have discussions with researchers in the departments of development economics and marketing; to meet with prospective PZA students; and to discuss financial and management matters.

Hans Jansen visited CATIE on August 3 to participate in a meeting with Agriculture Ministers of Central American countries.

Hans Jansen visited the MAG offices in Hojancha (Guanacaste) on October 13 and 14 to discuss research collaboration.

Jetse Stoorvogel visited Wageningen from October 13-20 to obtain his PhD.

Hans Jansen visited Wageningen between November 21-24 to have discussions with members of the Costa Rica working group; to meet with prospective PZA students; and to discuss financial and management matters.

III.2 Visits to other parties

On February 2, Hans Jansen visited the local World Bank office to brief staff on PZA research activities.

On February 6, Hans Jansen, together with Prof. 't Mannetje, visited the Dutch Ambassador in connection with 't Mannetje's candidacy for the CATIE Board of Directors.

Between February 26 and March 5, Jetse Stoorvogel visited the University of Florida in Gainesville for a workshop on "Exploring concepts and methods for ICASA systems, tools and application". He presented the USTED user shell, and incorporated the GIS module in the DSSAT new geostatistical module.

On February 27, Hans Jansen met with Franz Tattenbach, Executive Director of FUNDECOR, to discuss activities and potential for cooperation.

On March 27, Jetse Stoorvogel visited the UCR to backstop the GIS activities initiated by the "Centro de Investigaciones Agronomicas de la UCR".

During April 24-27, Don Jansen gave a presentation on USTED at the Cuarto Seminario Latinoamericano de Agromática, at the Instituto Tecnológico in San Carlos, Costa Rica.

On May 30, Jetse Stoorvogel attended a conference at the Erasmus University,

Rotterdam on "Business organizations and sustainable development". He gave a presentation on technology transfer of alternative management practices in Costa Rica.

Hans Jansen visited the Costa Rica office of the Free University Amsterdam on July 1 to participate in a seminar.

Jetse Stoorvogel participated in the annual meetings of the American Association of Agricultural Economists, held August 6-9 in Indianapolis, USA, delivering a paper and presenting a poster.

Hans Jansen participated in the Primer Taller Nacional sobre Indicadores de Desarrollo Humano Sostenible a Nivel Local, held August 30 - September 1 in Birrí de Heredia, and presented a paper.

Hans Jansen participated in the Seminario sobre Avances y Perspectivas del Desarrollo Sostenible en Costa Rica, held October 25-26 at IICA, Coronado, and presented a paper.

Hans Jansen visited Mali from November 26 to December 2 to participate in the final PPS workshop and to present the USTED methodology.

Hans Jansen visited the Antenne Sahel program in Burkina Faso on 3-4 December to discuss cooperation.

Hans Jansen visited the OECD in Paris on 5 December to present the USTED methodology.

Don Jansen visited IRRI (the Philippines) from 3-10 December to participate in the SAAD-2 conference and to present a paper and a poster.

IV. Visits to REPOSA

Five WAU students (Department of Tourism) visited on January 23.

Frans Wielemaker (regional crop protection specialist, Dole Bananas, Standard Fruit Company), together with the Director of Research of Dole, visited on January 31 to explore possibilities of using GIS in the context of decision support systems for optimal input management at the farm level.

Prof. Leen 't Mannetje visited in the first week of February, mainly in connection with the research of Sergio Abarca.

A team of researchers from Wisconsin University visited on February 13, in connection with cooperation with CATIE in the development of joint research proposals in the livestock area to be submitted for external funding; and for a demonstration of USTED.

Charles and Myrna Hall (University of Syracuse) visited on February 22, to give seminars and for a demonstration of USTED.

Miriam Méndez of the UCR visited on February 23 to obtain data information and publications.

Michael Richards (ODI, UK) visited on February 24, for briefing and publications.

Roger Norton, Consultant/Economist, visited from March 7-9, to review PZA modelling efforts.

Johan Bouma, Louise Fresco, Arie Kuyvenhoven, and Bert Boerrigter visited the program during different days during the period from April 4-13, to review progress,

elaborate the work program in detail culminating in a detailed time schedule, and to elaborate the TOR for the successor of Don Jansen.

Toine Jongmans, Peter Buurman, and Ed Meijer visited the program from May 8-19, to select and sample different climo-sequences in the Guanacaste area and the Atlantic Zone. In addition Ed Meijer supervises the fieldwork part of a doctoral thesis from student Marjon Plantinga.

Aad van Tilburg, Associate Professor in Marketing, visited the program from April 30 until May 11 to work on the marketing book; to supervise Susan Hoekstra's research; and to develop general outlines for future marketing research.

Arthur van Leeuwen, PhD. candidate in the Department of Forestry of the WAU, visited the program from June 8 to 29, to finish up earlier field work.

Professor Kees Karssen and Bert Boerrigter visited REPOSA from July 2 to 7.

Muhammad Ibrahim visited REPOSA on August 9 with an international group of students in the context of a CATIE agroforestry course.

Leen 't Mannetje visited REPOSA in October to review progress of the PhD. research of Sergio Abarca.

V. Students

A total of eighteen students have been associated with REPOSA during 1995, up from fourteen in 1994 (table 1).

TABLE 1 STUDENTS SUPERVISED BY REPOSA (CATIE/UAW/MAG) STAFF DURING 1995			
NAME	INSTITUTION	RESEARCH AREA	DATES IN CR
de Korver, Caroline	Wageningen Agricultural University	agronomic aspects of coffee in Guanacaste	8-'95 until 11-'95
de Ligt, Linda	Wageningen Agricultural University	agroforestry (MADELENA CATIE); agronomic aspects of mango in Guanacaste	1-'95 until 8-'95
Joenje, Mark	University of Amsterdam	Economics and adoption of improved pasture technologies	3-'95 until 9-'95
Kuiper, Marijke	Wageningen Agricultural University	Incorporation of erosion in land use evaluation models	11-'95 until 6-'96
Louis, Fopco	Wageningen Agricultural University	Palm heart mulching experiment	1-'95 until 4-'95

Plantinga, Marjon	Wageningen Agricultural University	Redistribution of trace elements upon the weathering of volcanic ash soils in Costa Rica	8-19 May 1995
Pluimers, Jacomijn	Wageningen Agricultural University	Palm heart mulching field experiment; modelling of pesticide leaching	8-'94 until 4-'95
van der Schot, Anna	Wageningen Agricultural University	Economic aspects of coffee in Guanacaste	7-'95 until 11-'95
van der Steeg, Jeannette	Wageningen Agricultural University	Location of farm types in Atlantic Zone	12-'94 until 6-'95
van Putten, Erik	Wageningen Agricultural University	Comparison of rapid soil inventory for Atlantic Zone with existing detailed soil map	5-'94 until 4-95
van Vulpen, Guido	Wageningen Agricultural University	Land use zoning Guanacaste with GIS	1-'95 until 6-'95
Uijtewaal, Esther	Erasmus University, Rotterdam	Effects of pesticides on human health	1-'95 until 8-'95
Wijffels, Mirjam	Wageningen Agricultural University	Farm typology in Guanacaste	1-'95 until 8-'95
Winter, Albert	Wageningen Agricultural University	Detailed soil inventory for part of Guanacaste	4-'95 until 7-'95
Grant, Carlton	Universidad de Costa Rica (UCR)	Effects of tree shading on pastures	entire 1995
Barrantes, Gerardo	National University (UNA)	Ecological accounts for the Neguev settlement in the Atlantic Zone	1994-95
Efrain Zelado	CATIE	Effects of tree shading on pastures	entire 1995
Jose Urgiles	CATIE	Development and application of animal production systems in LP models	6-'95 until 3-'96
Paz, Napoleon	CATIE	Development and application of animal production systems in LP models	6-'95 until 3-'96

VII. Publications

The USTED methodology was presented at major international conferences in the USA (Annual Meeting of the American Agricultural Economics Association) and the Philippines (second symposium on Systems Approaches for Agricultural Development, SAAD-2) as well as at numerous conferences and symposia held in Costa Rica (Cuarto Seminario Latinoamericano de Agromática, San Carlos; Primer Taller Nacional sobre Indicadores de Desarrollo Humano Sostenible a Nivel Local, Birrí de Heredia; and Seminario sobre Avances y Perspectivas del Desarrollo Sostenible en Costa Rica, IICA, Coronado).

Publications of REPOSA in 1995 (by subject area and type of publication)

Soil science and geology

Dissertations

Stoorvogel, J.J., 1995.

Geographical information systems as a tool to explore land characteristics and land use. PhD thesis, Wageningen. Agricultural University, The Netherlands

Refereed publications

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VIII. Financial aspects

For 1995, the following budgets were available:

Operational costs	df1 671,000
Ex-patriate personnel costs (excluding salaries)	df1 241,000
Total	df1 915,500

Program expenses during 1995 were well within budgetary limits. A total amount of approximately df1 765,000 was spent during 1995. Part of the left-over of about df1 150,000 was transferred to the 1996 budget to cover existing financial obligations from the year 1995 and some extra activities in the 1996 work plan.

IX. Concluding remarks

As of the end of 1994, *USTED* was operational at the level of the county. Work in 1995 focused on (1) the upscaling of the methodology towards the regional level, *i.e.*, to make *USTED* operational for the county level and initiate work at the level of the Atlantic Zone as a whole; (2a) initiating crop data collection and (2b) producing a soil inventory in the province of Guanacaste, to operationalize and test *USTED* in a region with significantly different bio-physical and socio-economic conditions than the Atlantic Zone; (3) improving the sustainability-related factors in *USTED*; (4) summarizing past marketing-related research in the Atlantic Zone for publication in the CATIE Technical Series; and (5) summarizing past soil-related research in the Atlantic Zone for publication in the CATIE Technical Series as well.

Besides the above-mentioned main working areas, there are a number of peripheral, though not less important, working activities in which significant progress was achieved during 1995. These include the completion of a palm heart mulching experiment which main conclusion is that mulching may not be economically attractive, having important implications for input strategies of palm heart farmers; an economic evaluation of improved pasture technologies in the Atlantic Zone of Costa Rica which concluded that even though replacing the native grass vegetation with a mixture of the grass *B. brizantha* and the legume *A. pintoii* is very profitable, the same mixture in combination with two legume trees (*Erythrina berteroana* and *Gliricidia sepium*) is not; and the completion of a transport cost study which allows the calculation of sub-region specific input and output prices within the Atlantic Zone. Furthermore, there are a number of projects both within and outside Costa Rica that make use of REPOSA data bases.

A special issue of the Netherlands Journal of Agricultural Science (NJAS, Volume 43, Number 1, titled 'Quantitative land use analysis in Costa Rica), published in April 1995, is entirely devoted to the *USTED* methodology. The REPOSA geographical data base was made widely accessible through its publication in the form of an atlas. Besides the papers in the above-mentioned special issue of NJAS, a number of articles were published in other

internationally refereed journals. In addition, a number of presentations were given in both national and international conferences. Finally, numerous demonstrations were conducted to familiarize various interested organizations in Costa Rica with the methodology.