From Strategy to Reality

The Path to Institutional Excellence in Harsh Times

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Our Mission

To improve the well-being of mankind

through
research and higher education

in agricultural and related sciences for
development, conservation and sustainable
use of natural resources

in the American tropics
Looking back:
Planning and re-engineering

- Planning Process in 1992-
  - Participation of Stakeholders from the onset
  - Dynamic vs. static planning: Bi-annual updates
  - Planning levels: long, mid-term, short-term
  - Assessment mechanisms for follow up

- Re-engineering process 1993-

Agenda for a Critical decade. Strategic Plan 1993-2003
- Prepared in 1993, revised in 1995
- Under revision in 1997

Institutional Development Plan

Mid-term plans of Programs
- Prepared in 1994 and 1995
- Bi-annual updates

Workplanning
- Bi-annual

CATIE's Gender Policy
- Prepared in 1996
Looking back: Funding

- Strategies for core-project support
  - Donors as partners
  - Endowment fund
  - Foundation

- Strategies for income generation
  - Productive activities with private-sector efficiency
  - Definition of institutional "market niches"
Looking back:
Partners and allies

- Co-operation with strategic partners
  - The common agenda was concerted and agreed upon
  - Shared responsibilities and benefits

- Strategies for Regional Expansion
  - Covering the key countries in the mandate area

- Differentiated Strategies for different countries
  - Conditions and needs
  - Resources, capabilities for co-operation
Strategic positioning: Reading the trends

- Interpreting political trends
  - Less emphasis in Central America
  - Emphasis in poverty and environment
  - New mechanisms for co-operation

- Interpreting policies for development aid
  - Emphasis in the triangle:
    • Poverty alleviation
    • Environmental protection
    • Food production
  - Donor co-operation and integration
  - Gender policy
Strategic positioning:
Defining priorities

- Interpreting stakeholders’ priorities
  - Emphasis in training
  - Emphasis in information
  - New tasks and opportunities (valuation etc.)

- Adjusting CATIE to prepare for new situations

- Prioritise:
  - Education - Research
  - Research: Focusing and working in partnerships
  - Outreach: Work through partnerships and use modern communication technologies
The Outcome: Education

- Demand: 4x
- Number of graduate students: up 40%
- Higher standards for entrance
- New product for new demand: Ph.D. programme
- New alliances: USA, Canada, Germany, Denmark, Sweden etc.
- Persons trained in short courses: 5x
- Donor reaction: support doubled

M.Sc.:

In four areas:
- Sustainable Agriculture
- Agroforestry
- Forestry and the Management of Biodiversity
- Environmental Economics and Sociology

Oldest program of its kind in Latin America
More than 1000 graduates

Ph.D.:

New program, started in 1996
In partnership with universities in the USA and Europe
In two areas:
- Tropical Agroforestry
- Tropical Forestry
Students in the postgraduate school

![Graph showing the number of students, applications, and admitted students from 1992 to 1997. The graph indicates the number of persons for each year, with bars for Applications, Admitted, and Students. The graph is labeled with years from 1992 to 1997. The x-axis represents the years, and the y-axis represents the number of persons. The data shows an increase in applications and admitted students from 1992 to 1997, with a peak in 1996. There is a note 'Up to September' indicating the time frame of the data collection.]
In 1996, 274 training events were held:
  20% at CATIE's headquarters in Turrialba, Costa Rica
  76% in member countries
  4% in other countries
On the average, 24 persons/event
The Outcome: Outreach

- Emphasis in electronic information systems and connectivity
- World-wide coverage of information services
- New partners: IPGRI, EU etc.
- Alliances at the national level
- Emphasis on networks
- Donor support: currently app. 50% of project budget, including core-budget support
S & T = Science and Technology
Outreach: Example
The Madeleña project

Intensive research on fast growing forest trees in Central America (> 14 000 sample plots)
- Scientific information system (MIRA) for data collection and management
- Networking research: international allies, national institutions
- Efficient extension network:
  - 6 countries
  - 31 network organizations
  - 650+ extensionists
  - 20 000 farmers directly contacted
  - 80 000 neighboring farmers reached through multiplier effect

Reference:

Dynamic Linkages with Partners and Allies

- Headquarters
- National Technical Offices
- Serving the Member Countries
- Projects
- Networks
The Outcome: Research

- Focusing on strengths
- Consolidation of Interdisciplinary research teams
- Refereed publications: 4x
- New partners in research:
  - CIFOR, CIRAD, ORSTOM, NRI and other research institutions
  - Universities in Brazil, Finland, Denmark, Germany, Sweden, UK, USA etc

The mid-term plan "Research lines" prepared in 1996
Definition of research priorities
Formation of interdisciplinary research groups
The Outcome: Integration

- Integration of Research and Education
  - Scientists, professors, and students make up research teams
  - Scientific and academic excellence

- R&D feeding Outreach
  - Linking the production of information closely with its dissemination
  - Regional impact, institutional relevance
Our Strength in the Future

Is in the Integration of Three Major Functions

Research

Outreach

Education

CATIE - October 1997
The Lessons Learned

- Constant sensing of future trends and demands
- Planning processes at all levels
- Continuous monitoring, evaluation and impact assessment
- Frequent external evaluations
- Constant feedback from stakeholders
- Differentiated strategies for services and income generation
- Cost/benefit sharing with partners
- Accountability, transparency
- High efficiency and effectiveness
Research at CATIE: Strategy

- Focus on problem solving research through interdisciplinary research projects
  - Definition of five priority research lines
- Regional coverage through networking
- Collaboration with international research institutions and universities
- Collaboration with NARS and universities in the region
- Contribution to the strengthening of R&D in member countries
Research at CATIE: Resources

- Qualified personnel
  - 20 Full time researchers - professors with Ph.D. degrees
  - 25 Researchers with Ph.D. degrees
  - 60 Researchers with M.Sc. or Lic. Sc. degrees
- Approximately 55 M.Sc. and 10 Ph.D. students per year
- Laboratories
  - Biotechnology, GIS etc.
- Experimental areas, data bases, information systems
- Collections
  - Coffea, Musa, Theobroma etc.
Research at CATIE:
Partners

- Co-operation with national institutions and universities in member countries
- Regional networks
  - REDCA, PROMECAFE, IPM, REMERFI, Agroforestry, Plantations
- Bilateral agreements with CGIAR centers
  - CIAT, CIFOR, ICRAF, IPGRI, INIBAP/IPGRI, ISNAR
- Bilateral agreements with universities and research centers
- Budget
  - Core: US$ 2 million
  - Projects: US$ 4 million
Research at CATIE:
Some examples

- Somatic embryogenesis of *Coffea arabica* as a tool of improvement
- Biocontrol of Black Sigatoka in bananas
- Long-term ecological and economic benefits from agroforestry systems with perennial crops and timber trees
- Diversified management of natural forests in the tropics
Effects of logging and silvicultural treatments on species richness

Treatments:

Control = No treatments
Log = Logging
Lib = Liberation
Shw = Shelterwood

Sites:

S1 = Corinto, Costa Rica
S2 = Tirimbina, Costa Rica
Future trends in research

- Emphasis on quality
- Problem-oriented research with verifiable impact
- Strengthening of partnerships with the international scientific community
- Networking with allies in the region
- Utilization of new technologies for research and development
- Full integration of research and higher education
- Research linked to outreach
Somatic embryogenesis of Coffea arabica as a tool of improvement

- Coffee is one of the most important crops in Central America, Jamaica, Colombia, and Brazil
- The varieties cultivated originate from a limited genetic base
- Low adaptability and high susceptibility to principal pests
- Duration of the conventional selection process: 20 to 35 years
Somatic embryogenesis of Coffea arabica: Objective

- Produce and disseminate high quality genetic material for small coffee growers in CATIE's member countries
- Increase the adaptability and productivity of selected varieties
- Better resistance to the main pests and diseases of the region
- Maintain or improve coffee quality
Somatic embryogenesis of Coffea arabica: Strategy

- Basic methodological research at CATIE's headquarters
- Applied research with national partners
- Pilot scale production in a well-distributed regional network
- Joint program since 1992 (PROMECAFE, CATIE and French Co-operation)
Somatic embryogenesis of Coffea arabica: Methods
Somatic embryogenesis of Coffea arabica: Advances

- All the selected genotypes tested (17) have been multiplied at a large scale with this process
- Development of a new bio-reactor (RITA)
  - Semi-automatization of the somatic embryogenesis process
  - From cell to plant in liquid medium and in the same bio-reactor
- High productivity
  - 6,000 plants ready for ex-vitro hardening/year/bio-reactor
- Converting somatic embryos to plantlets directly in the greenhouse (for the first time)

Presently, in vitro micropropagation techniques offer the only method for rapid propagation of the hybrid material. For this purpose, a high frequency somatic embryogenesis method (RITA) was developed.

Fifteen Coffea arabica F1 hybrids and the two parents of the variety "Nemaya" (Coffea canephora) were introduced in the laboratory in 1996.

The objectives of this work are the technical and economic evaluation of the in vitro process, the scale-up of production and field evaluation of the plants (agronomic performances, check-up on plant conformity through research of somaclonal variations) in four countries of the region (Honduras, El Salvador, Guatemala, Costa Rica).

The process will be transferred to national institutions in the member countries in the year 2000. Using this micropropagation process, a commercial diffusion of the improved varieties is expected around 2003.
Somatic embryogenesis of Coffea arabica: Results

- Reduction of the selection process from 25-35 to 5-10 years, working at the F₁ level
- Different varieties have been put forward
- It is possible to automate somatic embryogenesis by using liquid media (RITA technology)
- Mass production of plants at a low cost is possible

References:


Black Sigatoka disease in bananas

- Central America: 100 thousand hectares of banana plantations

- Main disease is the Black Sigatoka - caused by the fungus *Mycosphaerella fijiensis*. Management of the pathogen is based on the use of fungicides

- In Central America, approximately US$100 million is spent annually for fungicides in bananas
Black Sigatoka disease in bananas

- The use of fungicides causes human health problems and environmental contamination

- Result of frequent applications of fungicides:
  - Strong selection process by the pathogen with the consequent development of resistance
Biocontrol of Black Sigatoka in bananas: Objectives

- Reduce fungicide use in banana cultivation
- Reduce adverse impacts on human health and on the environment
- Look for antagonistic microorganisms to *Mycosphaerella fijiensis*
- Test their efficiency under screenhouse and field conditions
- Determine the effect of substrates on growth in the phyllosphere of the microorganism

Massive applications of bacteria could have unpredictable environmental effects. However, extracts of these bacteria applied to foliage are an alternative which favor antagonism, while decreasing their use frequency and potential risk. Thus, research is conducted to determine the effect of substrates on growth in the phyllosphere of chitinolitic and glucanolitic microorganisms.

Bacterial isolates were obtained from the cultivar “Grand nane” and tested for chitinolitic and glucanolitic production ability and compatibility with fungicides.

The efficacy of the selected microorganisms and extracts was tested in screenhouse and field conditions under high inoculum pressure of the fungus.

Bacteria present in the rhizosphere was selected to be applied to the plant root in order to look for effects on plant growth.

The laboratory and screenhouse research was conducted at CATIE and field tests were conducted at the Standard Fruit Company and The Humid Tropical Agriculture School (EARTH) in Costa Rica.
Biocontrol of Black Sigatoka in bananas: Results

- *Bacillus subtilis* and *Serratia marcescens* were as effective as fungicides to control *Mycosphaerella fijiensis* under greenhouse conditions.
- The selected microorganisms, *Bacillus subtilis*, *Serratia marcescens*, *Pseudomonas cepacia*, and *Pseudomonas fluorescens* showed high capacity for chitinase and glucanase production.

References:


Black Sigatoka: Biocontrol

Screenhouse

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The use of substrates: Increased foliar area

![Bar chart showing foliar area comparison between control, Serratia, P. fluorescens, and P. cepacia with Substrate 1 and Substrate 2.](chart.png)
Long-term ecological and economic benefits from agroforestry systems with perennial crops and timber trees

- In tropical America, approximately 1.5 million families depend on the income from coffee growing
- Farms with low capital input are vulnerable to fluctuations in coffee prices
- In the early 1970's, intensive coffee monocultures with high agrochemical inputs were promoted, leading to increased vulnerability
- The combination of perennial crops with timber trees offers a feasible solution
Agroforestry systems with perennial crops: Objectives

- Increase ecological and economic sustainability in small and medium-sized farms
- Increase productivity through improved production systems, and reduce vulnerability to changes in commodity prices
- Reduce adverse environmental impacts
- Evaluate the productivity of traditional and modern agroforestry systems and the ecological interactions between their components

The research was initially focused on the evaluation of traditional systems on private farms (case studies) carried out by CATIE staff and students. Most of the emphasis was on evaluating productivity (tree and crop) and biophysical variables, particularly nutrient cycling and other effects on soils (e.g. erosion reduction).

A second phase involved formal experiments both on-farm and on-station, particularly species trials of both native (traditional) and exotic shade trees. The emphasis shifted towards a more applied approach, with less emphasis on ecological interactions (light, water, nutrients), but increased emphasis was given to financial analyses, e.g. sensitivity analyses.

The third phase is aimed at generalizing the results of the site-specific research.
Agroforestry systems with perennial crops: Strategy

- Development of concepts and models of basic processes and their interactions
  - In collaboration with universities and international research centers

- Collaboration with a network
  - NARS, PROMECAFE etc.
  - Larger number of trial sites where standardized methodologies and protocols are used

- Complementary studies of traditional practices with national and regional sampling

References:


Agroforestry systems with perennial crops: Results

- Increased sustainability and diversification in production
  - High returns to labor and capital in *Coffea arabica* with *Cordia alliodora*
  - Timber trees in coffee plantations: up to 40% of the present net value
  - Coffee bean size increased with shading

- Positive impact on the environment
  - Increased inputs of organic material and carbon to the soil
  - Low levels of nutrient leaching

- Change of policies of national coffee institutes from seeking maximum productivity to seeking sustainable productivity

Timber shade for coffee (*Coffea - Cordia - Erythrina*):
Increased farmer income
Benefit/cost ratio increased by 20% and return to labor by 25%
  when *Cordia alliodora* was introduced into traditional coffee plantations under *Erythrina poeppigiana*
Nitrogen fixation - 60 kg ha\(^{-1}\) yr\(^{-1}\)
Carbon fixation: 2 - 5 t C ha\(^{-1}\) yr\(^{-1}\)
High coffee production: 2 tons of beans ha\(^{-1}\) yr\(^{-1}\)
Wood production: 10-15 m\(^3\) ha\(^{-1}\) yr\(^{-1}\) of which 70% was commercial timber

Timber shade for cocoa:
Increased farmer income
*Tabebuia rosea* and *Cordia alliodora* produce 9-18 m\(^3\) ha\(^{-1}\) yr\(^{-1}\)
without affecting cocoa production
Carbon fixation: 5 - 7 t C ha\(^{-1}\) yr\(^{-1}\)
Diversified management of natural forests in the American tropics

- Present area in the American tropics: 6 million square kilometers
- High deforestation rates: 0.7% for Tropical Americas, 1.6% for Central America
- Natural forest management for production is currently high on the agendas of governments, NGOs, scientific organizations and forest owners world-wide
- In rural areas, millions of people could benefit from sustainable, diversified management of natural forests
- Limiting factors: information on management, no long-term experimentation and monitoring
Diversified management of natural forests: Objectives

- To contribute to the development of viable methods for diversified management of natural broad-leaved tropical moist forests

- These methods should be:
  - socially acceptable
  - ecologically sustainable
  - economically attractive, and
  - technically viable

- Diversified management refers to the sustainable production of both timber and non-timber products
Diversified management of natural forests: Strategy

- Long-term research is planned, and will be centered around a series of Key Sites
  - Sites in priority biogeographic and political regions in which forest areas are managed by the forest owner (private or community)
  - Costa Rica (6), Nicaragua (2), and Guatemala (2)
  - Scientific information system for standardized data collection and processing

- Partnership with CIFOR
  - Additional Key Sites for secondary forests in Peru, Nicaragua and Brazil

- Transfer process and feedback through networking
Diversified management of natural forests: Results

- Long-term sustainability in terms of volume
  - Sustainable extraction: 20-30 m³ ha⁻¹
  - Increment in the total volume and the volume of potentially commercial species

- Long-term sustainability in the composition and distribution of species
  - Logging does not decrease the number of species - silvicultural treatments may

- Economic feasibility depends on cost and price structure, market situation, and policy environment

- Research results have been used to establish guides for policies and practices of forest management

References:


Colours (from top down):
Light blue: Gavilan = Pentaclethra macroloba
Velvet: Palms
Green: Non-commercial species
Blue: Preferred species
Orange: Acceptable species
Extracted volumes using a moderate management scheme (cutting cycle 20 years)

Gavilan = Pentaclethra macroloba