

**CENTER-COMMISSIONED EXTERNAL REVIEW OF
SPATIAL ANALYSIS
AT THE
INTERNATIONAL CENTER FOR TROPICAL
AGRICULTURE (CIAT)**

REPORT

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EXECUTIVE SUMMARY

1. A key strength of the CIAT Land Use Project (LUP) is the fact that it is made up of a group of dedicated and enthusiastic staff. Over the last two years considerable effort has been made with respect to improving the strategies and processes that will assist the team in delivering outputs of major importance to CIAT and its mission. The key findings of this review are that these strategies and processes can be further developed and enhanced through paying attention to a range of research and research support functions.
2. An evaluation of current activities suggests that, given a limited senior staffing complement, the range and number of activities being undertaken is too large. It is suggested that the Project develop better define its core business and focus. It appears to the CCER that the real objectives of the LUP, and indeed of CIAT, are moving in the direction of helping communities adapt and cope with the impacts of global change, whether the result of climatic and associated environmental factors, or economic and social drivers. Similarly, a great strength of the project and CIAT is the fact that it has the capacity and capability to integrate agrobiodiversity and germplasm factors with environmental and socioeconomic factors to deal with poverty alleviation. This clearly defines CIAT's competitive advantage on the international stage. Focus for the LUP project needs to be developed in this context. It can be achieved by the development of three project sub-themes that are strongly aligned with CIAT's three research themes. This approach can be further enhanced by a strategic analysis of the LUP's internal and external clients.
3. An assessment of the quality of research indicated that much of the project's work is innovative and on a level with the standard expected from a CGIAR center. Whilst the Project has a good track record in terms of dissemination of data, information and modeling products, it is considered that publication in internationally recognized peer-reviewed journals is currently inadequate and ultimately will be to the disadvantage of the Project and CIAT.
4. The CCER consider that the above focus and alignment of work will enhance the project's ability to seek external co-investors in research highly relevant to CIAT's mission. This will assist in the development of critical mass in key sub-themes. It should also reduce the risk that an uncoordinated external funds pull will drive project staff in a number of different and uncoordinated directions.
5. A potential strength of the LUP is its capabilities with respect to spatial data and information analysis and management. The CCER consider that this can be enhanced by further attention to training of other CIAT project staff in basic GIS techniques and striving for international best practice with respect to data validation processes and descriptive metadata.
6. With respect to research activities that will underpin the proposed strategic focus for the group the CCER are concerned that, rather than individuals continuing to develop new tools and models *ad infinitum*, such models are only contemplated when there is a clearly defined need or user demand. Instead, it is more important that the Project focus on developing an integrated

modeling toolkit that links together existing models where appropriate, and provides a common CIAT ‘look-and-feel’ to the toolkit.

7. Gaps in the LUP’s strategic skill base have been identified in this review. These include remote sensing, epidemiology, terrain analysis and geomorphic processes. The CCER consider that where these skills are needed the best approach will be for the LUP to collaborate with other institutes who have strengths in these areas.
8. Finally, whilst we recognize that CIAT’s competitive advantage lies in the integration of environmental, economic and social factors, there will need to be some incentives developed both within the LUP and across CIAT to ensure that integrative capacity is capitalized on., This could be encouraged by the instigation of “Flagship” projects supported and initially funded by the CIAT Executive.

RECOMMENDATIONS

Vision and focus

1. *An overarching vision statement for the LUP and probably CIAT as well could include the concept of “Helping communities adapt to global change”*
2. *The LUP should focus its research into three new sub-themes that underpin the CIAT themes covering national, watershed (catchment) and local scales.*
3. *The LUP focus its efforts to integrate biophysical and socio-economic research and development in order to provide clients with implementable triple bottom line (environmental, economic, social) based solutions to their problems*

Strategy

4. *The LUP conduct a strategic analysis of its key internal and external clients in the light of strategic directions recommended in this review.*
5. *The LUP develop new strategic and business plans to improve focus of the science and better targeting of funding agencies.*
6. *The LUP should focus its modeling and methods work on the development of a toolkit for use by researchers and clients. This toolkit should include the current suite of models and should have a common look and feel to facilitate its use. Less effort should go on developing yet more models and tools in the future. More will be gained through applications to solve key problems.*
7. *Consideration be given to gradually increasing the geographic coverage of the project into Africa and Asia through development of generic toolkits*

Staff issues

8. *All scientists particularly at a senior level, are strongly encouraged to publish more of their work in international peer review journals. Also a tracking system for publications of all types should be implemented and used to review the status of publications at regular intervals.*
9. *The LUP should develop as part of its planning processes a succession planning policy that will allow for seamless continuation of key underpinning science activities. Recruitment of new staff and postgraduate students should also be focused around the CIAT and LUPs themes and sub-themes to increase capacity and critical mass.*

10. The LUP needs to ensure that all staff are made aware of their responsibilities and accountabilities in terms of all aspects of project design, execution, delivery and publication.

Research support

11. The LUP should consider providing a spatial data support service with a “Helpdesk” to other CIAT Projects to facilitate the improved use of databases and GIS information across CIAT.

12. The LUP should take steps to review its data collections, improve metadata for major databases and data quality validation procedures to conform with international best practice.

Impact

13. The LUP develop or adopt methodologies to assess the impacts of their products.

Integration of environmental, economic and social research

14. CIAT through its Executive consider instituting a process to develop Flagship projects that integrate environmental, economic and social research. These could be funded by a “call-in” of core funds, optimally co-invested with external funding.

INTRODUCTION AND TERMS OF REFERENCE

Terms of reference

The Center Commissioned External Review team was asked to answer three basic questions by CIAT management. These were:

1. Is the research direction clear and appropriate?
2. Are research activities suitable, given opportunities and constraints?
3. Are activities being implemented effectively?

The specific Terms of Reference of the review are :

- To review the origin of the project in relation to overall demands and to assess its current status in terms of funding, people, activities and strategy.
- To assess whether strategic directions are appropriate, given:
 - Existing and potential strengths / weaknesses of the project and CIAT
 - Opportunities and threats presented by agricultural development
- To comment on the overall quality of the research deployed to achieve these goals and ways in which it could be improved through, by example, linkages with other research groups or institutions
- To review the process of research implementation, given available resources and the need for consistency within CIAT. Where appropriate, specific advice should be offered on mobilizing resources.

Further to the above the CCER was asked in terms of benefits and impacts to:

- Give clear guidance to the CIAT Board on the positioning of the project with respect to the research portfolio of CIAT, and its relative capacity to deliver.
- Clarify specific issues for the project:
 - What? What research activities are suitable and what are not and which new activities should be considered
 - Where? In which geographic regions should activities be focused, in relation to emerging issues and secure partnerships?
 - With whom? How does CIAT manage the project? Which groups interact well with the project, how it should clarify functional linkages? What new linkages should be explored?
- When? What timeframes are realistic to achieve stated goals? What activities should be accelerated?

Review process

The review team assembled at CIAT on Thursday 20th November. Meetings were then held with the Land Use Project Leader Dr Simon Cook, The Research Director, Dr Douglas Pachico, and the Director General, Dr Joachim Voss, to discuss the ToR and to set the scene for the review. Formal subproject presentations were made to the CCER as part of CIAT's annual review process on 24th Nov. The rest of the time available was taken up with interviewing collaborating groups within CIAT, project staff, a one day field trip, and report writing. This report was presented to the CIAT Board on Monday Dec 1st.

This report commences with an evaluation of the current LUP activities. This is followed by an analysis of the scientific quality of the LUP, and a series of suggestions regarding future directions, structure and management, integration of biophysical and socio-economic approaches, current gaps in the project and collaboration opportunities.

A list of all staff interviewed is appended to this report.

EVALUATION OF CURRENT ACTIVITIES OF THE LAND USE PROJECT (LUP)

This evaluation is based around the written material provided, the subproject presentations and additional information provided during staff interviews. The project documentation indicates that the goal of the Land Use Project is: “To reduce the risk of agricultural development in the tropics by providing spatial information about significant opportunities and risks of natural resource”.

According to the Land Use Project Flyer, the LUP is currently structured around the following themes:

1. Data capture
2. Biological mapping
3. Socioeconomic mapping and spatial epidemiology
4. The CGIAR Challenge program on Water and Food (CPWF)
5. Indicators of vulnerability
6. Development of site-specific tropical agriculture

Project outputs are defined in the annual reports as:

- I Baseline and time-series data for subsequent analysis
- II Information and insight of biological limitations and drivers of land use change
- III Analysis and prediction of socio-economic factors influencing land use development
- IV Analysis and prediction of vulnerability of land use systems to significant external events
- V Methods of capturing farmers’ knowledge in land use decision support: site-specific agronomic management in tropical cropping systems

Although these 6 themes and 5 outputs generally overlap there appears to be a lack of an overarching conceptual framework that targets the research foci of the LUP.

We also examined the different scale levels used in the themes and outcomes mentioned (Table 1).

Table 1: Scales by themes

Scale	Biophysical	Socioeconomic	Integrated
Global	2, II		
National	2, II	3, III	IV
Regional	IV	3, III	5
Landscape			
Local			6

The biophysical research is more focussed at global and national scale levels, the socioeconomic research is more at the national and regional level. The more integrated approaches usually deal with

the regional to local approaches. Surprisingly the landscape/watershed level appears to be somewhat underrepresented in the research.

EVALUATION OF THE OUTPUTS IN THE 2003 ANNUAL REPORT

I. Baseline and time-series data for subsequent analysis

Strong points: the quality and infrastructure of the GIS lab is in the process of ongoing upgrade.

There is capability to develop new techniques and methods for more advance use of the data.

Weak points: there is no clear data quality indication nor comparison with other data sets. For example, it would help to make an assessment of the CIAT climate data base quality in comparison with other globally used data sets which are commonly use in global change research (examples are the IIASA data and the Potsdam PIK data by Wolfgang Cramer).

Clients: are the CIAT researchers. Apart from some atlases published, the data as such has no clearly defined external user group

Where: the data mostly involve Latin America, Africa and Asia. The focal area is Central America.

General evaluation: The need to store and document data is a core activity of very GIS laboratory. There should also be a meta-data base in order to have all these different data based well organised and easily retrievable. This is standard routine (or at least, *should* be) and is and remains a highly relevant activity. Without good model documentation and error/uncertainty indications the data are unreliable. Issues to address are errors, source documentation, ownership, and confidentiality.

II. Information and insight of biological limitations and drivers of land use change

Strong points: The combination of germplasm data with climate and soil data <FloraMap> in order to target collection gaps, species richness, and optimising collection strategies, is a unique research niche for CIAT. No other institution or research institute has this combined knowledge. Especially the link between spatial heterogeneity and the generation of genetic diversity appears to be cutting edge research in the realm of biodiversity research.

Weak points: The methodology of <FloraMap> and <Homologue> is highly dependent on the database quality. The spatial resolution could be improved, but this should be based on reliable new data instead of more sophisticated interpolations. In particular, the soil information used in <Homologue>, based on the WISE database, cannot be interpolated in a straightforward manner as suggested by the application in output 2.5. The temporal variability of some soil properties is too high to allow realistic spatial interpolations (e.g. properties related to organic matter).

Clients: researchers of CIAT (Land use, Beans projects), USDA and the biofortification Challenge Program with involvement of national institutes.

Where: Mostly Latin America and some activities in Africa

General evaluation: The matching of the germplasm data and knowledge with spatial climate data by means of the developed tools can be potentially powerful. The spatial work in biodiversity is especially novel. The germplasm targeting is novel as well, but related to ongoing activities in various groups of how climate change affects the migration of species and vegetation types. The changes in natural vegetation (IIASA, IMAGE model RIVM) in relation to climate change has links

with <FloraMap> applications. The unique niche for CIAT is availability of germplasm of crops. The current course resolution 10' grids and the continental extent limit regional and higher resolution applications. Furthermore, a link with socio-economic and relief-soil information could significantly enhance the power of the tools developed.

III. Analysis and prediction of socio-economic factors influencing land use development

Strong points: Making socioeconomic information available in a spatially explicit format is already a challenge in its own. The first steps of the spatial analysis in Ecuador are highly promising, especially when the socioeconomic and biophysical data are combined to analyse the livelihood sustainability. The step towards risk assessment is promising. The incorporation of uncertainty in DSS systems is certainly a step forward in allowing users more informed decision making.

Weak points: More systematic analysis should be made about the causes of the gap between decision making and information supply. Is the proposed DSS tool the real solution, or is it again a research-push approach? The projects described certainly have a great struggle in closing the gap between scientific information and policy makers. More theoretical research might be needed. Another weak point is the quality of the data (in terms of their resolution, as well methods of collection). Maybe a more integrated analysis could provide more targeted use and need identification of spatial tools.

Clients: CIAT researchers, National institutes

Where: Latin America only (probably because of limited data availability for Africa).

General evaluation: This is highly relevant research for Global Change related adaptation and poverty alleviation policies for which there is a clear external demand. Surprisingly it isn't more in demand within CIAT, given the main mission on poverty alleviation. This could be an institutional issue.

IV. Analysis and prediction of vulnerability of land use systems to significant external events

Strong points: This is one of the first systematic spatially explicit attempts to map and describe vulnerability.

Weak points: The use of indicators is a highly subjective and static way of presenting vulnerability. It is probably done this way in order to make it easy for policy makers to digest results. The issue of accumulated errors/uncertainty is an issue which needs more research. Especially error propagation by using different combined models needs to be addressed in the future.

Clients: World Bank, national institutes. Currently, there is no demand for its use within CIAT, although with the three new emerging themes this may change.

Where: Only Central America

General evaluation: The vulnerability mapping is clearly in demand by external agencies, but not yet within CIAT. This is highly relevant research for Global Change related adaptation policies for which there is a clear external demand. This topic is also high on the research agenda of the LAND project of the IGBP for the next decade.

V. Methods of capturing farmers' knowledge in land use decision support: site-specific agronomic management in tropical cropping systems

Strong points: This theme has a large potential value, given the mission statement, CIAT has to link with the local rural land users.

Weak points: a point of concern is the wide range of different apparent unrelated activities under this theme. It is about low altitude imagery, farmer's perception, estimating soil parameters, soil biology variability on slopes, crop performance on trial fields, rubbery scales and fuzzy criteria, and local GIS application.

Clients: CIAT land use project.

Where: Latin America

General evaluation: This work in progress. The research still has to prove its value. We strongly recommend more effort to develop a conceptual framework and to use that framework to focus the research activities within this theme. Given the CIAT mission to link with the local poor people this research theme is relevant. Given the limited concrete outputs the real contribution of this type of research remains to be proven. There should soon be a moment of evaluation in order to redefine the goal of this theme.

Summary points from the evaluation

The CCER were impressed with the fact that virtually every member of staff interviewed indicated that Dr Simon Cook had, since his arrival in 2001, made a very significant improvement to the focus, direction, collaboration with other projects and morale of the project. We consider that the LUP is consequently moving in the right direction. The suggestions and recommendations made in this report are aimed at refining, reinforcing and possibly accelerating this process with an emphasis on scientific focus and management issues.

An overall evaluation of these themes and outcomes, demonstrates that they are all together not very well focused. There is an obvious need for a less open and more focused and integrated strategic research agenda. The outputs of the project include donor reports and products (CD tools) and a limited number of peer reviewed papers and book chapters.

During the interviews it became apparent that, for example, there is very limited integration of the more socioeconomic oriented research and the biophysical spatial research within the Project. Given the mission of CIAT more integration of socioeconomic and biophysical data and research is needed. Land use systems as such are spatially explicit systems which include interactions between biophysical and socio-economic drivers operating at different scales. It is, therefore, essential to have the activities happening at overlapping scales and themes.

We therefore propose to integrate the research in three more integrated (both in terms of theme as well as scales) foci or subthemes that support CIAT's overall research agenda.

The three proposed relevant research foci:

- Agro-biodiversity (including germplasm targeting and socio-economic implications)
 - from global to sub-national level

- Land use system dynamics (integration of socioeconomic and biophysical drivers)
 - from national to regional-watersheds level

- Adaptation to environmental and socioeconomic risks in highly variable local environments.
 - from landscape-watershed to farmers field level

A fundamental underpinning activity related to good GIS practice in general is:

- Data gathering and documentation

And finally, depending on the user and or client of the project, there should be attention to the following two activities:

- Effective dissemination of data and insights
- Clearly recognisable CIAT products and toolkits (generic products)

These suggestions are discussed further in the next sections of the report.

RESEARCH QUALITY

A concern was expressed by senior management in early interviews regarding the quality of the research on the international stage.

Analysis

An analysis of the publication record of the group was hampered by the lack of a centralised database of publications, although a list of the publications by the group over the five-year period 1999-2003 was compiled by the Review Team from LUP Annual Reports, shown in Table 2.

Table 2: Analysis of publications between 1999-2003 by staff of the Land Use Project

International refereed journal articles	
Published	19
Submitted	4
In preparation	3
Book chapters	
Published	10
Submitted	
In preparation	7
Conference papers	79
Reports and technical manuals	118

Clearly, much of the group's output has been in the form of conference papers, reports and technical manuals, all of which are unrefereed. Of the refereed publications (i.e. international journal articles and book chapters), 29 publications across 8 staff members over a 5 year period ($0.75 \text{ publications person}^{-1} \text{ year}^{-1}$) is relatively low for a research-only institution. For comparison, the expectation in many European universities is $\sim 2 \text{ publications person}^{-1} \text{ year}^{-1}$, on top of teaching and administrative duties. Moreover, closer examination of LUP publications shows that the largest proportion of these refereed articles is from staff employed on a consultancy basis (5 first-author papers+7 non-first-author papers), followed by Research Fellows (4 first-author papers+5 non-first-author papers), and Senior Research Fellows (3 first-author papers+1 non-first-author paper). Senior staff do not appear to be publishing refereed articles at the international level (2 first-author papers+6 non-first-author papers), with no first-author refereed journal articles at all. On the other hand, a large number of unrefereed conference papers are being published, and efforts should be made by senior staff to convert at least some of these into refereed articles of high quality.

The quality of journals to which papers were submitted was generally high. Thus, it appears that the work that is published is of international standard, but that the proportion of LUP activities that is published at this level is relatively low.

We recognise that the impact of LUP's work is not measured by publications alone, although this has not been easy to assess. There appears to be widespread consensus that the tools developed by agroclimate component of the LUP are both of high quality and of considerable utility. In

particularly, <BEANMAP> was cited by a number of collaborating staff to be in great demand by a range of users, and to be producing useful information. Other products, such as <HOMOLOGUE> and <FloraMap> were also cited as being very useful, although this was probably restricted to the research community. There was a suggestion that the use of these could be extended further with more emphasis on policy-related research, e.g. environmental planning at the national level. The work on spatial distribution of population in Central America also had a major impact, as CIAT was the only organisation that was able to provide information for targeting of relief efforts in the wake of the Hurricane Mitch disaster in Honduras. At this stage, it is difficult to point to other concrete examples of impact.

Certainly, the group as a whole appears to keep abreast of new developments in the field. Novel approaches are being explored –the work, for instance, on Bayesian modelling of uncertainty is a useful start on quantifying the reliability of spatially explicit data, and has the potential to provide farmers with a range of choices along with the relative weightings of each choice. However, the considerable literature on Decision Support Systems should be considered, particularly in relation to designing products that are of actual utility to the end-user, rather than to scientist’s perceptions of it. There are countless examples of state-of-the-art DSSs that have remained unused on shelves. Similarly, the poverty mapping is attempting to go beyond the pure mapping of poverty, but also to try and understand the underlying causes of it. The spatial dimension allows patterns of poverty to be picked up that might not be immediately apparent from tables or verbal descriptions of the same data. This work has the potential to go much further with the inclusion of emerging approaches such as agent based modelling, and other paradigms from the field of artificial intelligence and social process-based modelling, which need to be explored. Members of the group are starting to think in this direction already, which is a good sign.

Recommendation

That all scientists, particularly at the senior level, are strongly encouraged to publish more of their work in international peer-reviewed journals. That a tracking system for publications of all types should be implemented and used to review the status of publications at regular intervals.

WHO ARE THE CLIENTS OF THE LAND USE PROJECT?

Analysis

The CCER was given the impression that much of the work of the LUP has been developed on the basis of science push rather than client demand. There are clearly some exceptions to this including work commissioned by the World Bank on vulnerability indicators, previous UNEP funding and contributions to agrobiodiversity work from USDA, USAID and BMZ (Germany). From discussions with the Land Use Project staff and staff from other CIAT projects it became clear that as well as having some external clients, the project has a strong demand for collaboration within CIAT across the majority of project areas including genetic resources, forages, beans, fruit and from outposted staff in Africa and SE Asia.

The CCER considers that the science-push, and in the past, a relatively, uncoordinated drive for external Special Projects funding, has impacted adversely on the LUP's ability to focus and coordinate its efforts in support of internal and external clients. To some extent, this is currently confounded by an inadequate definition of clients and customers for the outputs of the Project. Similarly an uncoordinated approach to clients and funding means that scientific directions will frequently be adversely affected.

The CCER can see that there is demand for the outputs of the LUP from at least two different client groups across three scale levels. The first of these includes national and international agencies concerned with questions such as the impact that climate/global change will have on poor populations at regional and national level. Such questions may include what will the effects of changing temperature, rainfall and growing season characteristics on existing crops and forages and what are the strategies that may be employed to sustain food production if these events happen? A second demand appears to be at watershed to sub-watershed scale for work related to poverty mapping and natural resources management issues from agencies such as Condesan. The third demand appears to come from the need at farm to "municipio" scales for implementable systems of land use and management that sustain or improve production and the natural resource base and which focus specifically at improving livelihoods of local people. The role of developing projects in collaboration with the NGOs at this level is apparent, as is the need to assess how site specific information can be extrapolated into adjacent and more distant locations.

Recommendation

It is recommended that the LUP conduct a strategic analysis of its key internal and external clients in the light of strategic directions recommended in this review.

ORGANISATIONAL STRATEGY AND FOCUS

Land Use Project focus

CIAT is currently under a process of metamorphosis in terms of strategic directions and focus. In particular, the definition of the three key themes:

- Genetic resources
- Restoring degraded lands to profitability
- Rural innovation

and the development of the CGIAR Challenge Programmes on Biofortification and Water and Food appear to be shaping the development of the research agenda without necessarily modifying the existing structure of the organization. The CCER consider that the increasing focus that contributions to these initiatives will bring is to be commended. However, we do have some concerns with respect to the extent that contributing to these important initiatives appears to be optional for individual scientists. We would like to see a more focused approach within the LUP that defines the directions that spatial analysis needs to take to provide critical support to these initiatives. This statement is based on many comments made to the CCER during discussions with CIAT staff. Whilst these generally were highly favourable with respect to the scientific capability of individuals in the group there was a strong undercurrent that suggested that the group is science push driven, has too much “hobby-science”, has not integrated its research strongly enough with the four key cropping foci of CIAT (cassava, rice, beans and forages), nor with the more recent additional focus on natural resource management.

It was also apparent from our interviews with staff that there is a tension in CIAT between maintaining a culture of science push research and development as opposed to moving towards more customer driven research. Whilst many breakthroughs have come from the former pathway, it is harder to serve the needs of key donors and clients with this model of operation. As core funds shrink there is an increasing pressure to obtain external or “special project” funding. If approaches to this are not well planned and concentrated on “core-business” there is a high probability that research groups will lose focus and strategic direction as the search for funds pulls individuals in different directions. This emphasizes the need for a strategic and business planning at both Institute and Project level. We strongly recommend that the LUP revisit its previous planning documents and prepare new strategic and business plans for the next 3-5 year period. The strategic plan should focus on alignment of scientific directions with the three defined themes of CIAT and on the way in which the project will coordinate and focus its science and staff to deliver key outputs to these themes. The business plan should deal with how the scientific strategies will be achieved in terms of external funding, internal structure and support, succession planning, and data management. It should also define who is responsible and accountable for seeking external funding and for the various stages of project design, execution, delivery and scientific publication. Without a thorough understanding of accountability of staff at all levels, there is a likelihood that the best laid strategies and plans will fail.

There is a considerable degree of concordance in many Advanced Research Institutes that, in environmental and agricultural sciences, many (but not all) new advances will come from the successful integration of biophysical, economic and social science, sometimes referred to as the 'triple bottom line' approach (also known as the Planet, Profit, People approach). The need to use a triple bottom line approach with respect to poverty alleviation and development issues is also critical and is clearly recognized by many donors. So it is important that the LUP, and CIAT as a whole, pay considerable attention to processes that will facilitate the identification of problems and issues that require an integrated approach and the processes whereby this can be achieved across the institution. The CCER consider that if CIAT can successfully do these things, it will be strongly positioned on the international stage. Evidence that integration can be achieved is already there in terms, for example, of the excellent development of the germplasm by environment mapping tools. These can, and should be, strengthened by incorporating socio-economic factors into analytical approaches. These will really strengthen CIAT's ability to determine increasing risks to livelihoods and potentially acceptable methods for poverty alleviation. Currently, CIAT has not only the ability to undertake these kinds of analyses, but also the resources across the Centre to commence work on alleviation of these impacts. This potential ability to integrate biophysical and socio-economic data in a spatial sense and deliver outputs across scales relevant to both policy advisers and farmers seems to us to indicate the real competitive advantage that CIAT needs to build on.

So the real question to the CCER with respect to the above niche for the CIAT LUP relates to what suggestions we can make that can help the development of the appropriate research directions.

In terms of staffing, the LUP has seven full-time PhD-level staff (Cook, Hyman, Winograd, Oberthur, White, Rubiano and Jones) supported by several postgraduate students and a considerable component of locally-hired BSc level staff. This means that the five research areas other than data capture really only have the input of 1 to 1.5 PhD-level staff. We question whether this is enough in terms of critical mass in specific areas, maintenance of science quality and research output, development of effective linkages within CIAT and with external collaborators, and succession planning. We also question whether, under current financial circumstances that this thin spread of senior staff is appropriate in terms of the increasing demands that marketing and fund raising will place on the project and its leader. We have already suggested that a more appropriate structure would have three areas of focus, in addition to data capture and management, which we see as a fundamental underpinning activity for all the LUP's work. Whilst not wanting to be too prescriptive, we consider that the clear areas of focus for the LUP should be related to its competitive advantage defined previously and which include the integration of biophysical, socio-economic data, information and models and spatial analysis tools and the application of this integrative package across scales.

The above limitations further support our suggestion that the LUP focuses on three sub-themes:

- Agrobiodiversity (including germplasm targeting and socio-economic impacts from global to national scales;
- Land use system dynamics (integration of socio-economics and biophysical drivers from national to regional watershed scales; and
- Adaptation to environmental and socio-economic risks in highly variable local environments.

If we consider these in terms of international issues that need to be addressed we believe that all three areas will help CIAT and the LUP to develop capacity to determine risks to livelihoods imposed by global change and to develop strategies to deal with these risks across a range of scales. Issues that might be addressed include work on vulnerability of major crop and forage systems to production decline in marginal environments as a result of climate change and variability, vulnerability and risks to agriculture and communities from high magnitude climatic events including hurricanes, floods and droughts, further work on identification of the factors controlling agrobiodiversity and the potential for developing improved germplasm for specific potentially productive and degraded environments, and the development of better understanding of the relationship between poverty and environmental factors through improved spatial analysis. Complementing the above should be work on specific strategies that allow individual farmers to adapt to risk through diversification, improved management and targeted marketing of higher value crops.

In our view, the above themes and issues to be targeted fit in well with CIAT's three key themes of genetic resources, restoring degraded lands to profitability, and rural innovation.

The CCER was asked to comment on geographic focus for the LUP. Currently, it seems that most of the key data sets that the LUP owns are focused on Latin America. However, it appears that increasing demand will come from Africa and Asia for the types of analytical approaches developed in Latin America. Similarly, the current international focus on poverty alleviation in Africa may also create a pull for more work there. Too rapid expansion of projects in Africa and Asia could put a heavy and unsustainable demand on existing staff resources. However, it is important that the needs for project activities in Africa and Asia are reviewed by the Project Leader in the light of the review of clients and their needs. It is also important that the move towards a generic toolkit and modeling approach discussed later in this report build a capacity for African and Asian applications.

Finally, the CCER also wondered if a change of project name would be appropriate to signal changes in focus and to make a break with the past?

Recommendations

That the LUP develop new strategic and business plans to improve focus of the science and better targeting of funding agencies.

The LUP needs to ensure that all staff are made aware of their responsibilities and accountabilities in terms of all aspects of project design, execution, delivery and publication.

The LUP focus its efforts to integrate biophysical and socio-economic research and development in order to provide clients with implementable triple bottom line based solutions to their problems

An overarching vision statement for the LUP and probably CIAT as well could include the concept of "Helping communities adapt to global change"

The LUP should focus its research into three new sub-themes that underpin the CIAT themes covering national, watershed (catchment) and local scales.

Consideration be given to gradually increasing the geographic coverage of the project into Africa and Asia through development of generic toolkits.

INFRASTRUCTURAL SUPPORT

The LUP has, over the period of its operation, built up a number of datasets and tools that are of high value to CIAT, its customers, collaborators and development science in general. It is vital that the project continues to pay attention to the infrastructural issues required to ensure that data and institutional knowledge and memory are not lost if key staff retire or resign.

The question was raised in early interviews with senior management that there were two alternatives for the Land Use Project – (a) that it should be purely a support unit for other projects with no research agenda of its own, or that (b) it should be a research unit in its own right with its own research agenda.

Training and communication

There was a general feeling amongst the other researchers and collaborators that, the LUP should definitely have a research agenda of its own (particularly one that involved strong collaboration with other CIAT projects), but that a basic support function would also be highly desirable. This would be both to carry out basic GIS activities (obtaining data, map-making, basic analysis, etc.) for other projects, and to provide basic training in GIS methodology for staff on other projects, so that they could perform much of this themselves in future work.

It was suggested that the first of these should be implemented through a Help Desk to provide a ‘one-stop-shop’ by an appropriate number of national staff, so that other CIAT projects know where to come. More advanced analysis requirements by other CIAT projects should be obtained by including the LUP as partners in project proposals at the time of development, rather than as an afterthought towards the end of the project, as was often the case.

Training by the LUP project to date appears to have been rather *ad hoc*, usually by mutual agreements with other projects, but it was felt that a more pro active and formal CIAT-wide training programme should be implemented by LUP. There may also be scope for training people from outside organisations, although CIAT costs might make this limited to specialised/more advanced GIS analysis (e.g. underpinning statistics such as multivariate analysis, etc.). There was a suggestion that the LUP could develop e-learning type modules, and that there could be a possible link-up with Learning Alliances for training.

Appropriate mechanisms for funding this support work would need to be developed, possibly using it as a small income stream to fund more strategic research. Possible proportions of support/applications/cutting edge activities could be 20%:40%:40%.

Data and database management

The LUP has some 6000 databases of spatial data, although a large proportion of these are not owned by CIAT, and, therefore, have restricted access. There appears at the moment to have been little

attention given to maintenance, documentation and cataloguing (metadata) of all of these databases, with any efforts in this direction being rather *ad hoc* and down to the individual concerned. The last two processes particularly need to be integrated into yearly workplans rather than thinking about it as a separate activity or just when there is nothing else to do.

It is also important that some effort is expended in making others at CIAT aware of what data is available, which will help in ensuring that LUP is included in future proposals at the time of conception.

An important activity is the standardisation of both databases and software within the LUP and across CIAT in general. Within the LUP, it is important in particular that there is a standardisation of the databases and software modules associated with the software products developed. Where appropriate, this should be in line with widely used international standards (or at least have the capacity to input and extract data in these formats, e.g. the ICASA standards for crop simulation models). Common subroutines used across all products should be gathered into a common library with good documentation. Larger sub-components with well defined program interfaces should then be gathered into a software 'toolkit' which could then be assembled in different configurations for different applications. Thought should also be given to the user-interfaces of the packages having a similar 'look-and-feel', at least for the LUP products. This could subsequently be extended to all CIAT software products - we learnt that the CIAT Information and Documentation Unit has a section responsible for databases and software development, but that there is currently no attempt at standardisation across the whole of CIAT for either databases or software. The attempts of standardisation across the whole CG system by the Consortium for Spatial Integration (CSI) should also be taken into account.

To some extent, standardisation and modularisation will address the issue of succession discussed in the next section. Some thought also needs to be given to developing a strategy for software updating in the future as new operating systems begin to appear. For example, the BEANMAP program is in great demand and is well used, but is written for DOS operating systems, and will need updating in Windows. One suggestion was that LUP should think about linking up with a commercial software company to minimise maintenance and succession problems, although there may be issues here in relation to 'open-source' software and data structures.

Is there a need for more data collection? This would depend on the type of data needed. Core funding should not be allocated to further data collection, but obviously if there is a need within a Special Project for collection of specialised data, this should be budgeted for within the SP proposal. It was mentioned that the main limitation is access to germplasm distribution data, but presumably if there is more focus on CIAT commodities, this wouldn't be a problem. The CCER understand that there is a move to increase the resolution of the climate databases from 18 km² to 1 km², which will be a useful development in mountainous terrain where climate changes with altitude can be extremely rapid on a horizontal distance basis. However, it is suggested that before this is done, that some validation against real data is made of the existing 18 km² databases.

This raises the general issue of the quality of the databases. It seems that few attempts have been made to validate many of the derived databases. We feel that it is important that a serious attempt is started to validate these (particularly the climate, and species distributions) so that users can feel confidence in their use.

In summary, it would be useful for the LUP to instigate procedures that clearly define responsibilities for all individuals concerned with data collection, storage, management and retrieval with respect to best practice.

Recommendations

The LUP should consider providing a spatial data support service with a “Helpdesk” to other CIAT Projects to facilitate the improved use of databases and GIS information across CIAT.

The LUP should take steps to review its data collections, improve metadata for major databases and data quality validation procedures to conform with international best practice.

SUCCESSION PLANNING AND BUILDING STRENGTH VIA COLLABORATION

Succession planning

Of major concern to the CCER is the fact that, assuming the criticality of the germplasm by environmental modeling approach to the LUP and CIAT, there does not appear to be an adequate written plan to replace the skills and competencies when key staff in this and other areas retire or leaves for other reasons. In essence, it seems that the key needs here relates to the development of an appropriate strategy to maintain and improve software already developed and also to nurture the development of individuals who have similar capabilities to determine site-specific environmental data as a basis for assessing germplasm suitability, adaptability and impacts on germplasm from changing environmental factors to that of current senior staff members.. Whilst ensuring that the underpinning work can be continued, it is also important for Project Management to consider the skills and competencies required to support the key areas of focus for the project once these are agreed. Careful consideration will have to be given to whether new staff with specific skills are hired, and/or, to what extent such skills can be obtained through collaboration with other research agencies. Similarly, the CCER recognize that postgraduate students working in the LUP provide additional skills and are generally highly motivated. It is suggested that as new students recruited to the LUP are asked to focus their work on the major research themes of the LUP. This will increase focus and critical mass, as well as provide potential new staff recruits with appropriate skills. Additionally attention needs to be paid to grooming staff for potential project leadership roles.

Recommendation

The LUP should develop as part of its planning processes a succession planning policy that will allow for seamless continuation of key underpinning science activities. Recruitment of new staff and postgraduate students should also be focused around the CIAT and LUPs themes and subthemes to increase capacity and critical mass.

Collaboration to enhance expertise

The Review Team identified the following gaps in the expertise to meet the strategic goals of the LUP:

Demography – Currently, the LUP has limited skills in demographic analysis. This may not be a limitation for relatively simple analyses, but if more detailed studies are to be carried out, there may be a need to identify appropriate people with demographic expertise. There may also be a need for expertise in health-related aspects of poverty, which is not currently in the group.

Remote sensing – the group is currently doing work on interpreting remotely-sensed images, but they lack personnel with training in this area. Particularly if there is a focus on the watershed/farm level, there may be a need for greater expertise from outside the group. Dr Yukiyo Yamamoto from JIRCAS, but seconded to CIAT Asia, may be an appropriate person to link with.

Dynamic land-use modeling – Dynamic land-use modeling (DLUM) skills are available in the group, but not currently being applied. Probably, there is no need to develop in-house DLUM skills, instead concentrating on developing links with appropriate ARIs abroad, from which LUP staff could gain both basic modeling skills and expertise in using current models.

Terrain analysis and geomorphological processes – Particularly in relation to understanding processes occurring at the farm level, there may be a need to have expertise in terrain analysis and a knowledge of geomorphological processes occurring at the watershed scale. A new recruit to the Project has experience in hydrology, but there may be a need to widen this expertise.

Soil fertility – The group also has limited soil fertility expertise which may be important in looking at long-term watershed and farm-scale processes. Whether this area could be enhanced through the development of better links with the TSBF programme now located within CIAT needs exploration

In addition, the Review Team identified the watershed level as having no ongoing work (see Table 1). However, since the 2003 Annual Report from which that information was compiled, a project has started together with CONDESAN, so this gap has been filled to some extent. The farm-level work may also have overlap with the watershed scale.

PROCESSES FOR INTEGRATION OF BIOPHYSICAL AND SOCIO-ECONOMIC RESEARCH

This kind of integration is only achieved when people from different disciplines respect and value each other and have a common goal.

There are four possible ways to stimulate this:

- Structure: within CIAT there should be a structure which rewards such integration activities.
- Capabilities: given the current biased disciplinary expertise within CIAT there should be more socio-economic scientists (not only economists) involved or hired with the capability to think and work in a spatially explicit manner.
- Methods: A way to integrate is using interdisciplinary modelling methods and tools such as land use and agent based models.
- Common goal: A flagship project could be formulated, based on one of the new research themes of CIAT, where the integration is a central theme to tackle poverty alleviation. We think that a top-down initiative including core funding would make this a successful strategy.

Recommendation

CIAT through its Executive consider instituting a process to develop Flagship projects that integrate environmental, economic and social research. These could be funded by a “call-in” of core funds, optimally co-invested with external funding.

APPENDICES

People interviewed during the review process

Staff List Land Use Project		
Name	Speciality	Position
Simon E Cook	PhD, Crop Biology	Project Manager
Glenn G Hyman	Agricultural Geographer	Senior Staff
Manuel Winograd	PhD, Ecology	Senior Staff (Outposted)
Thomas Oberthür	PhD, Geography	Senior Research Fellow
Douglas White	Agricultural Economist	Senior Research Fellow
Andrew Farrow	GIS Specialist	Research Fellow
Andrew Jarvis	Agricultural Geographer	Research Fellow
Jorge Rubiano	Agronomist and PhD, Geography	Postdoctoral Fellow
Rachel O'Brien	GIS Specialist	PhD student
Arjan Gijsman	Soil Scientist (CIAT/University of Florida)	
Peter G. Jones	PhD, Crop Physiology	Consultant
Staff List CIAT Projects		
Name	Speciality	Position
Douglas Pachico		Director of Research
Joachim Voss		Director General
Jacqueline Ashby		Director for Rural Innovation and Development Research
Miguel Ayarza	Soil Scientist	Coordinator for Central America, Honduras
Roger Kirkby	Agronomist	Coordinator for Sub Saharan Africa, Uganda
Mathew Blair	Bean Germplasm Specialist	Bean Breeder
James Cock	Genetic Resources Specialist	Project Manager, Tropical Fruits
Daniel Debouck	Genetic Resources Specialist	Head, Genetic Resources Specialist Unit
Carlos Lascano	Ruminant Nutritionist	Project Manager, Multipurpose Tropical Grasses and Legumes
Joseph Tohme	Plant Geneticist	Project Manager, Conserving and Using Tropical Genetic Resources
Edmundo Barrios	Soil Scientist	Project Manager, Overcoming Soil Degradation
José Ignacio Sanz	Production Systems Specialist	Project Manager, Communities and Watersheds
Rupert Best	Postproduction Specialist	Project Manager Rural Agroenterprise Development

Rod Lefroy	Soil Scientist	Coordinator for Asia, Laos
Nancy Johnson	Agricultural Economist	Impact Evaluation
Yukiyo Yamamoto	Remote Sensing	JIRCAS (CIAT Asia)
Rubén Darío Estrada		CONDESAN
Lee Calvert	Virologist	Project Manager, Rice Improvement for Latin America and the Caribbean

Comments from the CCER team on the review process

The following suggestions are made based on our experiences during this review.

- The length of the review process should be limited to 5-6 working days
- Although it was useful to get views from as many staff as possible, the law of diminishing returns applies. So probably a process involving interviews with a cross section of staff from within the project of concern and from selected collaborative projects would be an appropriate way to proceed rather than trying to interview all senior staff.
- The day on which presentations of the LUP activities were made to the whole institute was extremely useful
- The provision of limited paperwork and background reading about two weeks prior to commencement would be helpful.
- The courtesy and help from project support staff, especially Jenny Correa and Gloria Stella Torres was much appreciated, as was the facilitation of the entire process by Simon Cook.